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CHICAGO, SEPTEMBER, 1914.

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NOT A MONOPOLY.

THERE is a very perceptible tendency on the part of Bell telephone officials, of late, to disavow their old claims of monopoly. Theodore N. Vail in an interview in a July number of *The Independent* only goes so far as to admit that the trend of economic development has been antagonistic to the principle of private monopoly. He qualifies it, though, by demanding—and himself supplying—a definition of monopoly. In the explanation he harks back to the principle of a single regulated system in a community; the economic truth of which we will all concede. The only point he does not mention in this connection is that each community may have its own distinct system, so long as they all interconnect, thus preserving the advantages of monopoly and escaping its penalties.

But Vice-President N. C. Kingsbury in *Public Service*, under the heading "Wrong Ideas About the Bell System," goes farther than does his president. The "wrong idea" seems to be the belief that the Bell company has monopolistic aspirations. This is emphatically denied; indeed, two of the sub-heads are particularly striking as they declaim "Bell System Not a Monopoly!" and "Does Not Want to Stop Competition!" Says Mr. Kingsbury, "There was only one time when the Bell company had an absolute monopoly of the telephone business—nobody else had a look in—and that was when the Bell company gave service for a few hundred feet at the Centennial Exposition in Philadelphia in 1876." We are forced to admit the truth of this; but let it be said that this was not the company's fault; and indeed it did its best to maintain that ideal condition of 1876.

Quite näively and ingenuously the Bell vice-president reveals on the first page the *casus belli* of his attitude and article. "Now, it is a dangerous thing," he says, "to be a monopoly *at the present time* [our italics]. It is a dangerous thing to claim to be a monopoly, even if you are not, and it is even a dangerous thing to pass the accusation by without an emphatic denial. It is well to know just the facts in regard to competitive conditions in this country. Now, we are not a monopoly, and furthermore, we do not want to be a monopoly. The responsibility of financing the entire telephone needs of this country is in itself enough to cause the bravest man, or set of men, to shrink."

Also his explanation of the Bell reasons for buying competing independent plants is very interesting, to say the least:

"The question of merger, of purchase, or sale, has been a prominent question with us for the last few years, because in a great many instances the owners of the different telephone companies have wished to sell, and I

believe in no instance have we gone of our own volition to an independent company for the purpose of urging it to merge its property with ours or to sell its property to us; and I believe this is a fact, that we have withdrawn from a larger extent of territory in the past five years than we have entered. * * * It has not been nearly so important for us to purchase properties as it has been, in almost every instance, for our friends in the independent field to sell their properties to us."

Part of that paragraph, at least, deserves some more italics; but we leave it to our independent readers to supply the emphasis where it will do the most good. It is made clear that the Bell company always preferred to have its competitors prosper, and reluctantly bought their plants in a spirit of compassion only when begged to do so. This is a new thought to us, and we are glad to be set right about it.

But in any event, and whatever the testimony of history, the Bell company now is disclaiming monopoly and cheering for its competitors. It appears possible to us that a shrewd independent operator might see ways to work advantage out of this situation, and use the present diffidence and apprehensiveness of the Bell forces to advertise the strength of the independents.

TOLL CHARGES IN EUROPE.

WHEN we want to cite an example of the inefficiency of government-operated telephone service, we draw upon some of the nations of Europe. In that continent's present condition of turmoil it seems incongruous to write of its peacefully slumbering telephone system. But the European war has not affected the government ownership advocates in this country, and the facts of Europe's service are still facts.

It is often claimed by pro-government enthusiasts that the toll rates of Europe's lines are much less than those of this country. And they advance not only the claim, but many sets of figures which purport to prove it.

In examining such figures, it should be remembered that European toll line service is not up to the American standard. The charge for the so-called ordinary long distance service is considerable lower than what is charged in this country. The trouble, however, is that ordinary conversations are greatly delayed, owing to the limited number of circuits for handling the business and the preference given to military and government business. A person seldom asks for ordinary service, but invariably makes the call an urgent one, which is transmitted as promptly as circumstances will permit; but the charge for an urgent call is practically three times as much as for an ordinary one, and as most of the calls are booked as urgent, the rate is actually considerable higher than in this country. The management does not hold itself responsible for mistakes or delays in transmission. No calls or appointments are made free and one is required to call for the telephone number even at a distant station. If any one responds at this number the calling party must pay the rate quoted even if it is not the party desired. If one wishes to make a call for a certain party at a given number he is required to pay an additional fee, while in this country calls and appointments are made without cost. The information thus gained adds greatly to the value of our service, although this feature is often abused by those who scheme to get something for nothing.

Taking all things into consideration, the greater purchasing power of money in that country as compared with ours, and the fact that all classes of labor, clerical, skilled and ordinary, are paid from one-third to one-half less than in this country, the prices paid for service in Europe are proportionately a great deal higher than those paid in America.

THE WAR AND THE TELEPHONE BUSINESS.

THE effect of the European war upon the telephone business of this country will naturally be confined to dependence on the state of business in general. Those industries whose output is temporarily curtailed by lack of foreign shipments, either directly or indirectly, may refrain from taking additional service, which they would otherwise need. Those lines whose activities are increased by the absence of foreign competition, or by newly created foreign demands, will need more employes, more raw material, and hence more telephone service. If the two classes balance each other, the telephone operating business should remain normal, and the telephone manufacturing business be called upon for the usual equipment increases.

Into the intricate processes of manufacturing telephone equipment go, in large or small measure, a great number of different materials. All the common and some of the rare metals; a number of natural and synthetic chemical compositions; fabrics and their dye stuffs; all the various forms of natural and artificial insulations, as well as various oils and lacquers, are used in some quantity. Some of these materials are, of course, imported. Shellac, for example, comes from India and other parts of southern Asia. Metallic tin comes mostly from Cornwall, Bolivia, the Malayan peninsula, Australia and the islands Banca and Billiton in the Dutch East Indies. Platinum is mined in the Ural mountains between European and Asiatic Russia. The dyes used here are of German origin. The best magnet metal comes from Norway and Sweden, as does tungsten also. Rubber is a South American product, of course.

The difficulty of getting imported materials is not confined to the products of belligerent countries. The shipping of the whole world is demoralized, and trade, even with South American ports, is uncertain. Fortunately most of the imported material is of secondary consequence to the telephone business, and may readily be displaced by products of our own mines and factories.

Those American manufacturers of telephone equipment which have established branches abroad for the purpose of encouraging export business will be affected in some degree, but not to as great an extent as other lines of business. Europe's policy of state ownership of telephones has so retarded the development of the industry over there that the export business has never been very considerable, compared with the domestic business.

Altogether, the telephone industry should suffer very little because of the tremendous upheaval. Perhaps we may be selfishly thankful that the public service business does not depend upon the whole world for its prosperity.

MEASURED SERVICE ON PARTY LINES.

PORTLAND, Oregon, is "experimenting"—that is the term used by the local officials—with measured service on four-party lines. The new class of service allows thirty calls a month at a minimum rate guarantee of $1.50. Except that in Chicago the subscriber drops a nickel in a slot, while in Portland the operator keeps track of the calls, the service is identical with the cheap form of residence service which the Chicago Telephone Company has operated successfully for several

years. That is why we comment on Portland's use of the word "experiment."

Party-line service, we must all admit, is a necessity. Without it thousands of present subscribers could never afford telephone service at all; to say nothing of the bad economics of tying up the whole equipment of a line for a single subscriber whose use averaged a call a day.

And it is equally obvious that party-line service must be measured service. An unlimited service party-line is quite impossible. We make this declaration in the face of the fact that several thousand of them are working at this moment. But we think those who use them will bear us out—except the farmers, of course, all of whom on a line know each other and do not mind finding the line they want to use already occupied. Town folks are usually not acquainted with the other parties on their party line, do not care for the general line gossip that enlivens country life, and object seriously indeed to any evidence that there are others on the same wire.

Yet with unlimited service the parties on a line must and do constantly run afoul of each other. Each party uses his telephone just as freely as though it was a private line. That means that the wire has four times as much traffic, if it is a four-party, as would a private line. Under such circumstances it is useless to hope to get the line every time one wants it, or indeed half the time.

With a 30-call service at $1.50 a month, which works out at one five-cent call a day, the average subscriber uses just that single daily call and no more. What excess use there is practically never amounts to an average of two calls a day. The incoming calls, of course, cannot accurately be estimated; but since most incoming telephone traffic depends to a certain extent upon the volume of outgoing calls, they are seldom unduly numerous. The result is that in most cases the subscriber on a 30-call four-party line has the use of the wire whenever he wants it. The service is cheap, adequate for the limited needs of its class of subscribers, and eminently satisfactory.

So much for the subscribers' side of it. As to the operating company, it must be admitted that this class of service is not directly profitable. As a matter of fact, every installation may mean a loss. But the value rests in the fact that the service, being popular, puts a great number of homes into wire connection with all the business interests of the community, and so greatly augments the traffic, and consequently the value, of the system's business telephones. The result is that business houses are forced by the increased traffic to contract for additional srvice, or to pay more for what they have.

All the telephonses of a community are so interdependent, and the traffic on one line is so much a part of the convenience of other lines, that it is a mistake to judge the value of a class of service by its profit to the company. The 30-call four-party service is *par excellence* a builder of business for the whole system.

SILENT TELEPHONES.

WHEN a family owns a silent piano some enterprising salesman persuades them to buy an automatic player. But a silent telephone is technically somewhat different. In reality it is not the telephone but its number that is silent, in the sense that it does not appear in any directory. It is omitted at the express wish and request of the subscriber, who may have one of a number of excellent reasons for wishing to remain telephonically *incognito*.

Whatever those reasons be, the Wisconsin Commission some time ago handed down an opinion that it was all right. This decision is obviously dictated by common sense. If a telephone subscriber wishes to be unknown to fame, there is no reason why the company should insist upon publishing his name in its directory. It is still able to claim him as a unit in its numerical report of stations connected; and its other subscribers will still get the benefit of his outgoing calls—which are the messages that really make business for those other subscribers.

A man is morally obliged to answer his telephone when it rings, even though he may not be bound to go to the door when the door bell rings. When the telephone bell rings it means that the company is tying up a lot of equipment in his behalf, and he should release it as promptly as he can. If he does not want to be called, or wants his calls to come only from a certain selected list of friends, the obvious and proper way is to have his name omitted from the directory.

We are not arguing in support of the silent telephone number. The subscriber who insists upon it seems to be losing a good many opportunities for the sake of saving a little annoyance. Fortunately, most subscribers look at the matter just as we do, and would rather have their names appear a dozen times than not at all. The only point is that when a subscriber does insist on the silent arrangement, the company may grant it with confidence that it is within its legal and moral rights.

THE NEW YORK INVESTIGATION

Following weeks of careful work on the part of William McClellan, special engineer, and Danial V. Murphy, special counsel to the New York Public Service Commission, second district, in the investigation of the New York Telephone Company's metropolitan rates, the commission definitely announces its program of procedure in this matter.

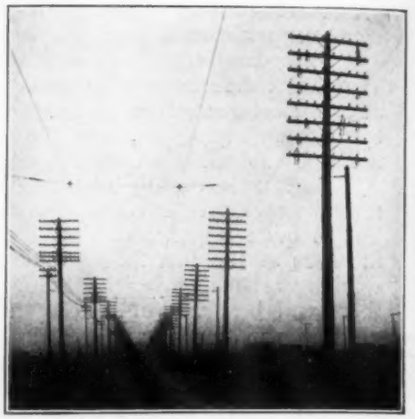
Hearings will be resumed on September 22, in the New York City office of the commission, at which time the telephone company has been notified that it must be prepared to proceed with the presentation of its case. The commission has refused to assent to the plan of the New York Telephone Company which involved a minute and detailed inventory of practically all of the company's property in three states, and through a letter from Seymour Van Santvoord, chairman, has warned the company that it will not countenance delay which will put a final decision of the matter beyond February 1, 1915. If necessary, the commission will hold continuous sessions in this matter after September 22.

The investigation will start with New York city alone, and will only involve those parts of the company's business outside the city which the actual investigation reveals from time to time as necessary for consideration in arriving at an equitable adjustment of the New York city rates, the specific matters complained of before the commission.

PROHIBITS FREE SERVICE IN ILLINOIS

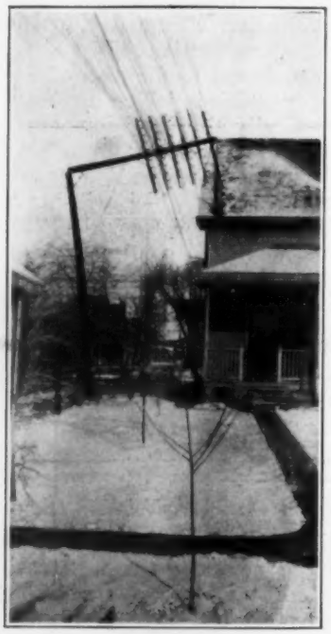
The Illinois Public Utilities Commission has issued an order regarding free telephone service and reduced rates, in which it prohibits telephone companies giving free telephones to cities and counties and to schools and lodges, but provides that telephone companies may, if they see fit, make a reduced rate for churches, hospitals, and other charitable institutions.

The New Chicago-McHenry Aerial Toll Cable at Its Junction with the Chicago-Milwaukee Underground Line.—Bell Telephone News.

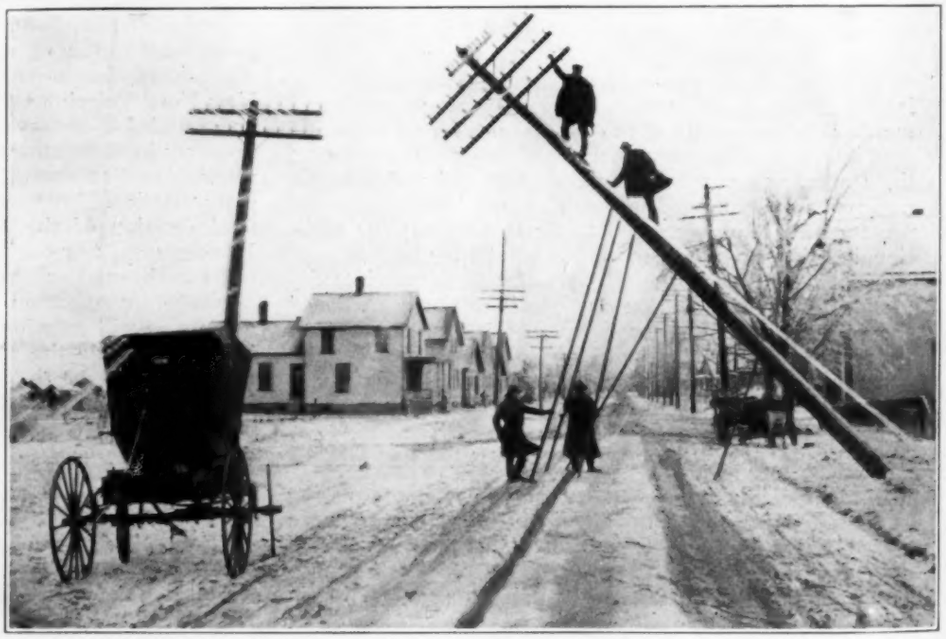


Facilities of the New Aerial Cable Exactly Equal Those of These Two Large Open Lines.—From The Bell Telephone News.

A Railroad Crossing on the New McHenry Aerial Cable. At Starting Point the Cable Has 54 Pairs of Quadded 13-Gauge and 15 Pairs of 16-Gauge Conductors, 69 Physical and 27 Phantom Circuits.



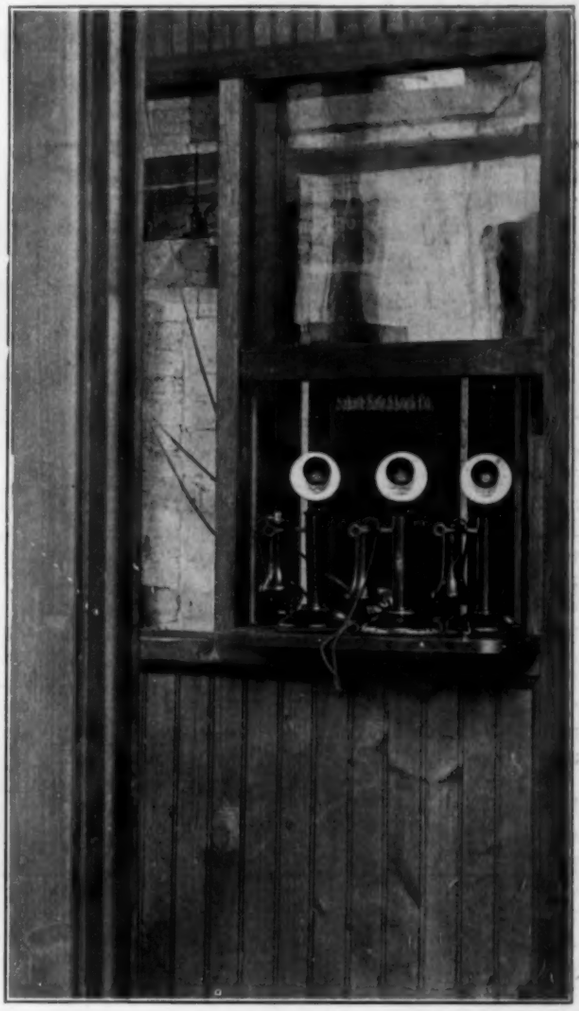
Storm-Broken Pole of the Eaton Telephone Company, Ohio, Last Spring.



Buggy Caught in Wires When Poles Fell at Sandusky, Ohio, Last Spring. Pole Is Head Guyed and Was Set Back on Old Stub to Keep Guy from Slacking.

STORIES IN PICTURES OF TELEPHONE PRACTICE AND PROGRESS IN ALL PARTS OF THE WORLD.

An Overloaded Telephone Pole Which Broke of Its Own Weight at Green Springs, Ohio.



This View of the Stockroom Window of a Chicago Garage Shows How Useful the Telephone Is to the Garage Owner.—From Garage Efficiency.

Canal Barge Loaded With Material for Rebuilding the Seneca-La Salle (Ill.) Toll Line on the Old Illinois & Michigan Canal.—Central Union Telephone Company.

Jack Meyers, Chicago Telephone Company Trouble Shooter, Starting Out on His Flying Merkel.

Kenneth A. McIntyre's Automobile Wireless Outfit at Toronto, Used in Connection with Home Station of One Kilowatt, Giving Communication Up to Ten Miles. Considered Successful as a Military Demonstration.

STORIES IN PICTURES OF TELEPHONE PRACTICE AND PROGRESS IN ALL PARTS OF THE WORLD.

Heroes of the Telephone Patrol Army

Jim McDonald was reclipping a telephone cable on a pole at an intersection of country roads when his handline became uncoiled and dropped to the ground. He was too absorbed in his work to notice the line, and it became entangled in the machinery of a speeding automobile. The car stretched the line out straight and it snapped like a violin string. The wire on which McDonald was swinging from his leather belt was vibrated so violently that he was sent whirling round it, somersault after somersault, until he had made a dozen revolutions. When the wire had steadied McDonald nonchalently slipped over the pole, unhooked himself, and came down with a grin.

"It's the first time I ever looped the loop thirty feet in the air," he chuckled, and went on about his business. McDonald is only one of hundreds of linemen who have thrilling experiences, many of which are tragic. There is a peculiar fascination about the work of the lineman, and when underground conduits took the place of poles in the cities he refused to be changed from an aeronaut to a mole, preferring the great open spaces of the country. The story of the shift from city to country, with descriptions of some thrilling incidents in the lives of these human spiders is told in the *New York Press*.

It is small wonder that the average city person has forgotten the existence of the lineman of old, for he seldom breaks into the news nowadays unless in a moment of carelessness or of the contempt bred of long association.

The life-saving service that patrols the sea coasts has for many years been the center of a little world of romance of its own, but who ever heard of the wire patrol—the patrol that year in and year out, in all kinds of weathers, marches its beat ceaselessly across the continent to fend business off of the shoals, to keep always flowing smoothly and steadily without break the telephone and telegraph stream on which is built the long-distance commerce of today?

To be precise, the Bell telephone system has in its employ about 15,000 men, who spend all their time watching the telephone wires that bind the country in a dizzy network of lines between the cities—the long-distance wires over which so much modern business is transacted in this age when time is literally money.

This army of 15,000 is operated and managed much like a regular army. It has its divisions and sections which correspond to regiments, and stationed with fine discrimination over the greater part of the country.

A large part of it is on duty constantly in watches or shifts. The remainder is kept in reserve, as a general keeps his reserve forces, to be called into action when emergency demands.

The enemies which this army must meet and conquer—for it must conquer, and it is its boast that it never yet has met defeat—are snow, wind, sleet, flood, fire and lightning. In other words, the elements are its foes. This army—or the wire patrol, it sometimes is termed—is made up of the old-time linemen.

It is a grim, lonely life they lead, those who have the watch in the long reaches of the Far West and Far South and Far North wires.

The patrol is bad enough. It is when the breaks occur that the lot of the lineman is hardest—when the wires have gone down for miles with the weight of the frozen sleet incasing them an inch thick, when the poles have been snapped off by the rush of the hurricane, when the floods have undermined them and they have toppled with miles of water barring approach to the scene, when terrific electrical storms have grounded half the telephones over a dozen square miles and the lightning has burned out wires and splintered poles and cross-bars.

In times such as these the patrol army earns all its pay. Two or three days without sleep, with very little food, and with the heat or cold almost unbearable, they stick to their guns, the trouble is righted, and the chatter of the world is whispering across the country. The work has turned out many an unsung hero.

Cable Telephone to Prince Edward Island

Halifax, N. S., and Charlottetown, P. E. I., were linked up by long distance telephone, July 6, via a cable that has just been laid across the Straits of Northumberland by the Dominion government. The service was formally opened with a conversation between Sir R. L. Borden, in Halifax, and the Hon. J. A. Mathieson, Premier of Prince Edward Island, in Charlottetown.

One of the terms of the Confederation was that communication should be maintained between the island province and the mainland, and the Borden government has adopted the policy that this communication must be as complete as possible and not something that was little more than a name. Hence, they have laid this cable to connect the lines of the Maritime Telephone Company with the island lines, and the company is to make no charge for the cable. All that the company will ask patrons to pay will be the land tolls, the cable transmission itself being free, and good either for telephone or telegraph. In the case of a breakdown of the telegraph cable, this telephone cable can be utilized. The cable is twelve miles long and runs from near Pictou to Wood Islands, forty miles from Charlottetown.

Nebraska Mutual Companies Exempt

All mutual telephone companies not organized for profit, which includes farmers' companies with small capital or no capital at all throughout Nebraska, will be exempt from paying penalties under the new income tax law for delinquency in reporting to the treasury department.

The other class of small telephone companies will be let off with a penalty of $10 for failure to report in the time required by the new law. Furthermore, where penalties had already been paid beyond the requirements of the order, congress will be asked at the next session by the secretary of the treasury, if not at this, to enact legislation authorizing reimbursement to such companies.

English Barred on Paris Telephones

Martial law is being more rigorously enforced in Paris daily. The authorities are particularly anxious to prevent the escape of important news and frequently take the precaution of tapping telephone wires, calls on which can now be made only in French.

This insistence upon the use of a language familiar to the police has been made necessary by the fact that suspected Germans were telephoning in English.

The restriction, however, is decidedly irksome to many English and Americans. The American ambassodor, Myron T. Herrick, was cut off when attempting to converse with friends.

The Automatic Cut-Over at Buffalo

The Story of the Federal Telephone Company's Abandonment of the Manual System

BY JOHN D. WELLS

CO-INCIDENT with the publication of this article, Buffalo, N. Y., is witnessing the consummation of an event of great significance in telephone history—the cut-over of a big manual system to automatic service.

It is of supreme interest to three classes of people: To the telephone engineer because it witnesses the final move in the construction of a great automatic system within a manual system without interruption of service in a telephone network serving a bustling city of approximately 500,000 people.

To Buffalonians generally because it affords them the very latest improved means of word transmission, a system vastly superior to any they have previously known.

Automatic Switches in the Ellicott Main Exchange Before They Were Covered.

To the independent telephone enthusiast because it marks one of the greatest strides ever made by an independent corporation, involving the expenditure of more than a million dollars, in the face of keen competition and in a field that is covered more thoroughly, probably, than any similar area in the United States.

Already the innovation is an assured success and Buffalonians have in countless ways shown their appreciation of the Federal Telephone & Telegraph Company's efforts to give the best possible service to its patrons.

The automatic system was first brought to the notice of the Federal Company largely through the efforts of Burt G. Hubbell, president of the company. Some two years ago, circumstances prompted him to begin a vigorous campaign for its adoption by his company to displace the manual system. In order that skeptical members of the board of directors might have an opportunity to investigate for themselves, they proceeded to form committees which visited various cities where it is in use. Some of the directors were frankly antagonistic and their methods were extremely unfair to the automatic. In every case, however, it met their objections automatically, so to speak, until every last director was not only convinced but made an enthusiastic friend and advocate.

Mr. Hubbell, realizing that back of the directors' convictions there was the public still to satisfy, planned a novel method of ascertaining the sentiment of the people of Buffalo and their attitude toward the new apparatus. A miniature exchange was installed in the company's commercial offices and full automatic service was established in all the leading clubs, department stores, hotels, newspaper offices and other public places. At each instrument an expert—one who could talk and demonstrate automatic—was posted. At each telephone was placed a pad of "expression blanks," on which the user was courteously asked to record his impressions of the automatic and, flatly—yes or no—whether he wanted to see it installed in Buffalo on the Federal system.

Federal Telephone and Telegraph Company's Commercial Offices, Corner of Church and Pearl Streets, Buffalo.

In six weeks upwards of 16,000 people answered most emphatically in the affirmative. Not one adverse report was received.

This, of course, was final proof and the system was formally adopted and the preliminary work started.

This preliminary work involved a campaign of publicity and education that was unique in its way. It is probable that nothing more complete has ever been carried out by any other telephone company.

Buffalo, a city of nearly a half million inhabitants

A Last View of the Old Apparatus in the Ellicott Street Exchange.

was wholly ignorant of the automatic. It seems almost incredible, but it is a fact that it was looked upon as an absolutely new thing in the world of invention. Few realized it is already in constant use in hundreds of cities and towns. Therefore, it had the merit of novelty and as such attracted great attention.

The campaign began in the Sunday papers. One paper used the story in a light way under the caption "Good-bye to the Telephone Girl." In plain English, such as the layman can understand, the use and principles of the automatic were set forth. Another Sunday paper used the story in a more technical manner, interesting and satisfying the technical reader. No public announcement had been made of the Federal's determination to adopt the automatic; the articles were offered merely as newspaper stories of a new invention. They attracted much attention.

Then followed the Federal's announcement. Simultaneously a complete exhibit set was established in the window of a big downtown department store. Many instruments were connected up; the first automatic telephone message passed between Mayor Louis P. Fuhrmann and H. A. Meldrum, president of the Chamber of Commerce. All this afforded a large amount of newspaper publicity.

Following this demonstration the Federal Company's "Spell Binding Squadron" was formed and a campaign of public speaking was started. During the last winter months, Messrs. Rich, Grauel, Brock, North and Wells addressed on an average twelve gatherings a week including church clubs, business men's organizations, technical bodies and women's societies. Probably close to 100,000 were thus reached by word of mouth, by means of a small 5-line demonstration set were made to actually see the advantages of automatic telephony and were interested as they could have been in no other way. Literature specially written for the Buffalo situation, was distributed at every meeting and the Federal standing in the community was enhanced to a surprising degree. A wave of sentiment for independent telephony was started that is still sweeping the city. The sincerity of this wave of popular opinion was shown when the first offering of a large issue of preferred stock authorized by the Public Service Commission was snapped up by the general public in eighteen days, it being considerably oversubscribed.

While the spectacular side of the work was occupying the public eye and mind, the engineering department had its work well in hand and the complete system now awaits the master stroke which will place it in operation.

For purposes of clear understanding the work performed by the engineering department and the results achieved, can be classified, briefly, as follows:

The problem at Buffalo has been to change from a single office manual system to a multi-office automatic system.

As a result of development studies, the city was divided into seven exchange districts—the central offices were located as near the center of each district as possible, the center being determined by a study of the distribution of population.

The establishment of several central offices meant the re-arrangement of the underground and aerial cable systems, each district being served from its own central office. In the former underground system, all cables were brought to the one central office. Some cables were brought from four to five miles.

To provide for the growth of the existing Federal system in Buffalo, and to extend it into hitherto unoccupied territory, it was necessary to install new cables, terminating in the new offices and connected to the old cables, which have been uninterruptedly in service. This arrangement will continue until the cut-over is made, when the cables will be cut and the subscribers transferred to the proper automatic central office.

OUTSIDE CONSTRUCTION NECESSARY TO MAKE CUT-OVER.

The construction of 66,000 feet of new conduit was a part of the general rehabilitation program of the Buffalo company, and the pulling in and splicing of approximately 60,000 feet of 150 and 200 pair of No. 19 gauge

One of Many Ways That the Federal Company Attracted Public Attention to Its New System.

cable is now finished. A total of nearly 90,000 feet of No. 19 gauge trunking cable is included in the complete system. These cables also contain No. 16 gauge conductors to be used for long distance trunking.

Approximately 125,000 feet of 50 and 100-pair No. 22 gauge cables was placed to be used for distribution purposes out of the seven central offices.

SIZE OF INSTALLATION.

When completed Buffalo will be furnished automatic telephone service from seven main central offices. At the time of the first cut-over, four of these central offices will be cut into service. The main central office will handle three regular central office districts besides its own until the other central offices can be completed.

Classes of service to be furnished from each central office are as follows:

(a) Direct line unlimited.
(b) Direct line metered.
(c) Direct line pay-station.
(d) Party line harmonic unlimited.
(e) Party line harmonic pay-station.
(f) P. B. X. service.

The number of lines provided for at cut-over from each central office is as follows:

Main	6,100	will handle	12,400 telephones
Elmwood	2,300	will handle	6,500 telephones
Humboldt	1,000	will handle	2,800 telephones
Central Park	500	will handle	1,400 telephones
	9,900		33,100

SPECIALLY CONSTRUCTED BUILDINGS.

The buildings that will house the equipment in the different districts are of special construction and design and built with the principal idea of excluding all dust. They have special heating and ventilating systems and a complete air compressor and vacuum cleaning system. All walls are finished smooth in hard plaster with rounded corners so as to reduce to a minimum the dust collecting places. The heating radiators are of special design so as not to be dirt collecting.

SPECIAL FEATURES.

All automatic equipment is of the latest two-wire type. Metered service lines are arranged so that the meter registers when the called party answers. Meters do not register when calls are made to offices or departments of the telephone company.

The party line equipment is arranged so the proper frequency of ringing current is automatically selected when party telephone number is dialed.

A special information desk is provided. All calls for information, time, changed number, etc., will be automatically distributed to idle operators who can receive no other calls while answering a call.

A special complaint desk has been installed to take care of complaints. All calls for complaint, information, time, etc., are made by dialing three-figure numbers.

SPECIAL TOLL FEATURES.

Subscribers will call "O" to get the toll recording switchboard. When long distance gets the subscriber, she calls back over a special No. 16 gauge trunk which increases the transmission over the use of No. 19 gauge trunks for this class of service.

Means are provided so that long distance operators are automatically advised by the use of discriminating tones applied to the calling subscriber's line when long distance service is to be denied, or "O. K." to be obtained from subscriber before long distance calls are passed, etc.

Each office is to have a special wire chief's testing desk for emergency purposes. All information, complaint and trouble are to be handed in the main central office.

Pay-stations are to be handled manually, calls to come to operators who will complete the connections desired automatically.

POWER.

Main Central Office: The installation consists of a 45 horsepower Alberger twin cylinder gas engine belted to a special Holtzer-Cabot generator, and a special Holtzer-Cabot direct-connected, 30 horsepower motor and generator.

Elmwood Central Office: One 15 horsepower Alberger gas engine connected to a Holtzer-Cabot generator; one direct-connected Holtzer-Cabot motor generator set.

Humboldt Central Office: One 10 horsepower Westinghouse gas engine coupled to a special Holtzer-Cabot generator; one General Electric 50 ampere mercury arc rectifier.

Central Park Central Office: One 10 horsepower Alberger gas engine belted to a special Holtzer-Cabot generator; one General Electric 40 ampere mercury arc rectifier.

There is a complete installation in each central office of 25 cells each of U. S. Light & Heating Company storage batteries, with a special means provided by the use of counter EMF cells to keep the voltage constant.

All existing telephone numbers have been changed and new five-digit numbers assigned for use after the cut-over. A corps of inspectors has tested out the new instruments installed, as well as all wiring, so that the entire equipment will be up to standard at the time of the cut over.

Superintends Public Schools Over Telephone

Dr. Holman White, district superintendent of schools at Philadelphia, Pa., was forced by a case of measles in his family to undertake the usual task of superintending the public schools by telephone.

His little daughter became ill and the case was diagnozed as measles. A regulation of the Board of Health requires that under such circumstances all persons connected in any way with the school system shall be absent from their posts. If he were a business man, he could continue his duties under certain other restrictions, but the susceptibility of children to such diseases prevented his attendance at his office, which is located in the Keyser School, at Morris and Coulter streets.

He established temporary headquarters in a building adjacent to the school and although but a few feet away from his regular office, he was able to supervise the schools without incurring any danger to the school children.

He dictated several hundred letters to his stenographer by telephone and used that medium of communication until the quarantine was lifted.

The American consulate general at Constantinople, Turkey, reports that the Minister of Posts, Telegraphs, and Telephones, has decided to draw up specifications on the basis of which concessions for the installation of telephone systems in the provinces will be accorded. The elaborations of these specifications will be taken up in the near future.

Attorney-General Grant Fellows of Michigan, holds that bonds of telephone companies secured by a mortgage which has been filed and on which the specific tax has been paid are not taxable.

The Stromberg-Carlson Telephone Manufacturing Company continues to issue from time to time its attractive bulletins and booklets on telephone apparatus.

European Telephone Development

Translations from the Foreign Press and Communications from European Engineers

BY FRED W. SCHOLZ

AN ARTICLE by Dr. Ludwig Kühn, in *Elektrotechnische Zeitschrift*, describes a new wireless telephone system. The possibility of utilizing electrical energy in the form of undamped high frequency currents, which are at our disposal due to the advancement made in building high frequency machines, offered the opportunity to work out a system of wireless telephony which would be an improvement over present forms. The only means that we have at the present time to force vibrations into the electric current, or better, the electric energy, is the microphone. Of course, it is understood that these vibrations shall be of a type to conform to the acoustic vibrations of spoken words. The microphone, due to its characteristic resistance features, represents a device which from the electrical standpoint has not a very wide range. As a matter of fact in the ordinary telephone microphone we have only fractions of a watt, which are transformed into pure alternating current energy. An improvement over this microphone is found in the so-called high tension microphone, but even here the utilization seems to be limited to an antennae energy of 1 kw. The demands made by wireless telephony are contained not only in as great an antennae energy as possible, but also (and this is the more important point), in that as great a quantity of energy as possible be transformed into useful energy through an acoustic rhythmitization of the electric sound waves. It is only this kind of current that can be used by way of the detector in the telephone for conversation, while the uninfluenced portion of the current in the detector and the telephone instrument might as well be called "dead," since it generates heat and nothing more. The result is that with increasing antennae energy we soon reach the extreme limit of microphone capacity, from which step on it is impossible to excite the current acoustically to vibrations capable of transmitting human speech. The author found in experiments that with an antennae energy of 7 kw. the microphone number of 72 was entirely inadequate, in that the utilization of this energy for speaking was too small, while the current load was in proportion far too large. In 1913 the author worked in the laboratory of the Ge-

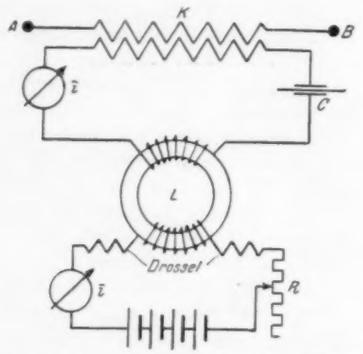


Fig. 1.—Proposed Wireless Telephone Diagram.

sellschaft für Dtathlose Telegraphie und Telephonie, under the direction of Count Arco, and succeeded in developing a wireless telephone system that seems to answer requirements. This system, which rests on a type of relay effect, seems to promise the use of any size energy. Practical communication was carried on for several months and distances of 600 km. were negotiated without any trouble whatsoever.

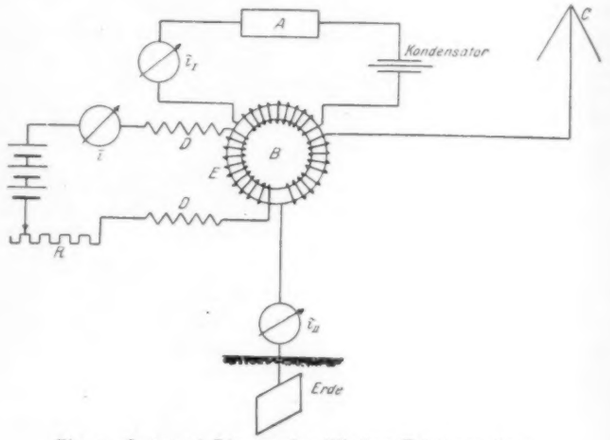


Fig. 2.—Improved Diagram for Wireless Telephone System.

First going slightly into the theoretical part of the problem, we may assume an enclosed iron body which has a coil, and is arranged in such a manner that through changes of the current in the iron all kinds of magnetic conditions can be obtained. We have then the law:

$$H = -\frac{0{,}4\,\pi}{l}.i.w$$

or since $B = \mu.H$ und $N = B.q$,

$$N = \frac{0{,}4\,\pi}{l}.q.i.w.\mu$$

By differentiating this equation, and since we have $e = L.\frac{di}{dt}$, we obtain for the self induction of the winding or coil, the well known formula:

$$L = \frac{0{,}4\,\pi}{l}.q.w^2.\mu.$$

The self induction is therefore a function of the permeability, and so a function of the magnetization current. We have therefore a means on hand through proper selection of the magnetizing direct current to change the self induction within certain limits. For the alternating current, compensation by means possibly of a second winding placed on the iron core, we would have a second variable reactance. Now if we assume such a self induction in an alternating current equipped with capacity and possible of being given a resonance effect, as is shown in Fig. 1, we have the beginning of a possible useful system. The alternating current would receive electrical vibrations or oscillations from some primary system by way of the transformer K. If then we set the direct current δ properly we will be able to bring the

alternating current circuit in resonance with the wave length assumed as standard, or else with possible established resonance to destroy the wave length and to untune the alternating current circuit.

In a practical way this latter possibility would show through a decrease of the current δ. It is obvious that the decrease in the high frequency current will be the greater in proportion, the greater the change in the influencing direct current. The decrease of the current i, to be known after this as "influencing current" will be the greater, the smaller the damping effect of the oscillating current circuit, since the change in the impedance is the greater in porportion, the smaller the resistance. In addition the degree of compounding or coupling of the transformer, *i. e.*, the electromagnetic connection with the primary system, and finally the relation of the self induction in the iron enclosed coil to the self inductions of the oscillation circuit has also some influence. The system to be used, based on the diagram shown in Fig. 1, is perhaps apparent.

In place of the current δ, which can be changed at will by means of a resistance, we will put a current which has the characteristics of an acoustically influenced current, which is being forced upon it at any time. That new current, *i. e.*, its pure alternating current component, we will call by the term "acoustic current." The application in wireless telephony will be to use a minimum of acoustic current and to influence with this a maximum of antennae energy to create a system which can be easily tuned and brought out of tune, in order to meet all the requirements for clearness of tone.

Of course, we will probably have to compromise between all our demands for a perfect wireless system. A small damping effect of the iron enclosed coil can be obtained only through a small self inductance, and a small magnetic connection with the primary system will mean a low utilization of energy. As in an economically useful wireless telephone system we would demand as great a utilization of energy, and influencing of the energy at command, there remains a compromise be-

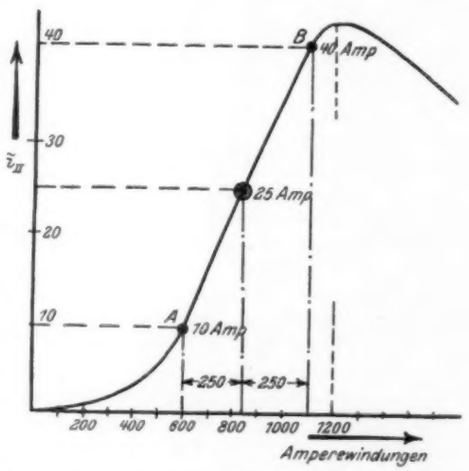


Fig. 3.—Resonance Characteristic of Wireless Telephone.

tween the damping of the enclosed coil and the relation of its self induction to that of the rest of the circuit. The problem of low damping effect can be met by using a large number of 0.02 to 0.04 mm. thick sheets of metal, having a very small electric conductivity and being well insulated from each other. A further step to increase the resonance qualities of the entire system is the one which changes the compound transformer K to a simple transformer provided with auxiliary magnetizations. This is shown in Fig. 2, where

A=a high frequency generator of constant period.

B=the compound (coupled) transformer (influencing transformer).

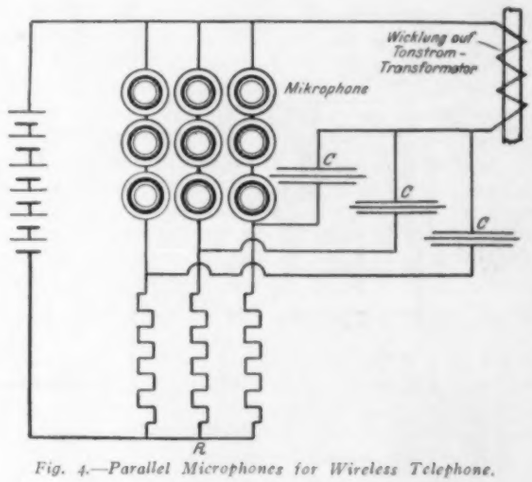


Fig. 4.—Parallel Microphones for Wireless Telephone.

C=the antennae.

D=two choke coils to take off the high frequency from the auxiliary circuit.

E=windings for auxiliary circuit.

We obtain two results through this arrangement: For one thing we reduce the "dead" self induction in the secondary circuit down to a minimum, limited by the self inductance in the antennae and a certain constant residue in the transformer B. But when changing the self inductance L_B, not only the secondary circuit but also the primary circuit are untuned, which reduces i_I and reduces i_{II} the antennae circuit even more. The author then made careful experiments concerning the resonance characteristic, the iron magnetization curve, and general acoustic effects, and gives the theoretical results in his original article. He found that the system answered most of the requirements and that it gave good results unless the speaker practically roared into the transmitter, when, of course, the vowels and consonants were not clear, which is the case, however, in every telephone instrument. Fig. 3 shows the resonance characteristic of the new system. In the abscissae, the measure for the influencing intensity is not in the form of currents but in the form of ampere turns.

It is clear, after fixing points A and B, that we need an ampere-turn number of 500 in order to reduce the antennae current from 40 to 10 amperes. If conversation is to be carried on, we need an amplitude of acoustic current ampere turns of 250, which corresponds to an effective value of 175. The selection of ampere-turns is immaterial as long as it is possible to bring the acoustic current through proper transforming to any desirable magnitude, for in order to obtain any kind of magnetic condition by means of alternating current, here the acoustic current, we need only consider the number of volt-amperes. In order to obtain the best utilization of the windings and a minimum of resistance, the acoustic current windings need be only 30, and the self induction of this winding will be 40,000 cm. These are values which correspond to the actual experiments made in the labora-

tory. The following example will show the sensitiveness of the system: Corresponding to an effective turn number of 175 and a number of turns of 30, the acoustic current may be 5.8 amperes. It has a period of 1,000, or a frequency of w=6,300. With the given self induction of the winding we have a self inductance tension of 1.47

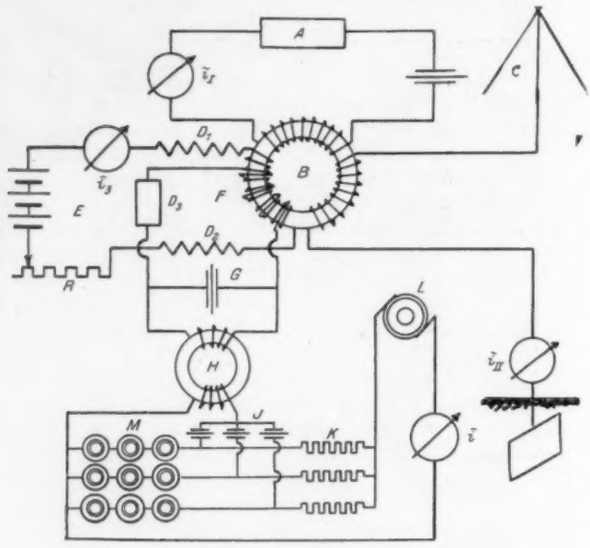


Fig. 5.—Complete Diagram of Wireless Telephone Set.

volts (the self inductance of 40,000 mentioned before is equivalent to about 850 ampere turns). The ohmic resistance of the 30 turns is about 0.05 ohm. This would give a loss of about 0.3 volt. The total tension at the acoustic current winding will then be: $\sqrt{1.47^2+0.3^2}=1.5$ volts and the volt-ampere number is equal to 8.7. These 8.7 volt-amperes, of which only about 1.7 watts represent effective capacity, are able to influence the antennae current rhythmically between 40 and 10 amperes with a period of 1,000 per second, which is within the range of human speech. If we assume for the antennae a resistance nearly equal to actual conditions of 5 ohms, the energy influenced will be $(40^2-10^2)\ 5=7.5$ kw. The total antennae energy would be $40^2.5=8$ kw.

In developing the sound producing system the author left the usual systems employed, and worked out a new circuit, in which the microphones lie in a direct current circuit, whose ohmic resistance is as great as possible, when compared to the average microphone resistance. A change in the latter will then cause only a slight or no change in the direct current. Instead of the ohmic resistance, an inductive resistance might be used. But this offers no guarantee for balancing the direct current conditions, as the resistance of the microphone is very unstable. The author employed electric bulbs, as the constancy of their light would give a splendid measure for the stability of the current in the acoustically incited microphone. When speaking into the microphone, *i. e.*, when changing the resistance in it, there result variations of oscillations which are directly proportional to the resistance oscillations. The advantage of this system lies in the possibility of parallel arrangement of any number of microphones, as is seen in Fig. 4.

The possibility of parallel arrangement of microphones is plain. The compensating resistance R placed at every branch guarantees the stable condition of all fundamental branch circuits, and the condensers C block the path effectively, so that there is no leakage of fundamental currents from one microphone set to another.

In Fig. 5 we have the entire telephone system assembled:

A=high frequency generator.
B=high frequency transformer.
C=antennae.
D^1—D^2=protective choke coils against high frequency for:
E=fundamental current circuit (13).
F=acoustic current circuit.
G=protective condensor against high frequency for:
H=acoustic current transformer.
I=blocking-condensors.
K=compensating resistances.
L=direct current source.
M=microphones.

We must still speak of the D^3 choke coil device, which is to choke off the high frequency in the speaking current circuit. In the direct current circuit E there is no difficulty in this direction on account of the iron core coils D^1 and D^2. In the acoustic current circuit F the matter is more difficult, since an increase of the low inductivity of circuit F would result in a decrease of the acoustic current. There would have to be an enormous increase of the inductance of the circuit, since the high frequency tension at the acoustic current coils might be between 500 and 1,000 volts. If 1 to 2 amperes high frequency current is permissible in F, which is possible, if the acoustic current transformer is short circuited for high frequency by means of a large capacity G, there would have to be a self inductance of 106 cm. in order to choke off the frequency, if we assume the period of the latter to be 80,000. This induction would decrease the acoustic current very much. The author finally met the problem in the manner shown in Fig. 6.

In this figure $S_{I,\ II}$ and $S_{III,\ IV}$ represent each a bifilar wound coil of very high self induction, S_V and S_{VI} represent a pair of coils insulated from the others and of very low induction. There is also a variable capacity C. With a certain value of the latter, an extraordinary choking effect against frequency was observed, while the reactance of the entire arrangement for low frequency corresponded to a self induction of about 20,000 cm. S_{IV},

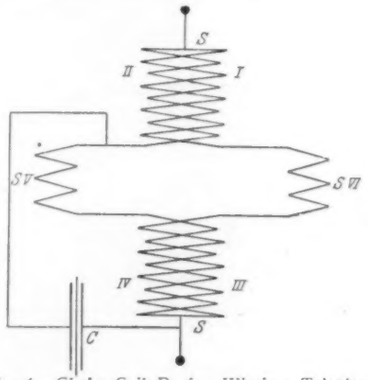


Fig. 6.—Choke Coil D_3 for Wireless Telephone.

C, S_V probably play the role of a current resonance circuit, whose effect is increased by the close inductive relation with the other elements of the system. The question of choking high frequency will, of course, offer even greater problems when it is a question of telephoning with 50 to 100 kw.

PROTECTION OF LOW TENSION AGAINST HIGH TENSION LINES.

C. E. WALSOE, a Danish engineer, has worked out a protective device for low tension lines, as used in telegraph and telephone work, which he claims has met all protective requirements in Denmark, and is said to have been adopted in various parts of the country. The device is shown in Fig. 7.

The tests were made with the device, a telegraph or telephone instrument being represented by a telegraph relay of 4,000 ohms resistance. This was placed in a wooden box which latter rested on a concrete base. One pole was grounded, the other was connected with the telegraph line wire by means of the ordinary 0.8 mm. insulated wire and insulators. The connection between low and high tension lines was obtained by means of a 1.25 mm. bare bronze wire, which was not melted in any case. The tests were made with three kinds of tension.

1. An alternating current at 220 volts toward earth, melted the fuse *C*, and melted the fuse *B*, whereby the connection to the instrument (relay) was interrupted. *C* was not injured; on the wire leading to the instrument there remained a tension of 220 volts however.

2. A direct current at 550 volts toward earth had the same effect, except that after melting of fuse *B* a light arc remained. Only when two fuses were placed in series, both melted and interrupted the current.

3. An alternating current at 6,000 volts passed through the voltage cut-out *A* and operated the automatic circuit breaker in the power station without injuring the low tension system at all. At the same time *B* melted.

The tests show that the voltage cannot reach the instruments at which operators work. However, the entrance wire up to fuse *B* retained 220 volts a. c. or 500 volts d. c. Walsoe proposes to make the fuse wire of fuse *B* so long that it will interrupt without fail and without production of an arc a direct current at 550 volts, and that it shall be possible to find out by means of measuring instruments whether the terminals leading to the instruments are without current. In addition he would use a 1 mm. wire instead of the 0.8 mm. on account of the high tension current used in test 3. He claims that there is no need of any special protection against 220 volts (d. c.). The same cannot pass the cut-out *C* and make *B* melt, and the resistance of Danish telegraph instruments is usually 2,000 ohms, and in this case the current could not increase to dangerous proportions, or else fall below 200 ohms, when it would melt fuse *B* and would not harm the instruments.

On the same occasion tests were made with direct contact between high and low tension lines, using a 1.25 and 5/mm. bronze wire. The fuse wire was connected either with an ordinary ground connection or directly with the sea. In the first case nothing happened with 220 volts a. c. or 550 volts d. c.; at 6,000 volts a. c. the 1.25 mm. wire melted and the 5 mm. wire operated the automatic circuit breaker at the power station. If the wire was connected with water, the fuse in the high tension line melted at 220 volts a. c. At 550 volts d. c. and 6,000 volts a. c. the 1.25 mm. wire melted, while with the 5 mm. wire, the fuse in the 550 volt line melted, and in the 6,000 volt line the automatic circuit breaker was operated. Walsoe draws the conclusions that where low and high tension lines are operated together the low tension lines should be placed above the high tension lines.

In discussing these results there seem to be several discrepancies and unjustified conclusions. It is not clear that Walsoe is right with the last conclusion drawn, at least from the experiments mentioned, nor does it seem that the protective system is so good that it obviates the use of mechanical protective devices at the power plants. If it is true that with contact with a 220 volt line there still remains a tension of 220 volts in the line to be protected, it is clear that there is danger for any workman or operator working with or on the line. The proposition to find out by means of measuring instruments whether the telephone line is in contact with a high tension line is practically out of the question in cities where there are hundreds or thousands of lines that would have to be tested. It is not clear either that there is no need of further protection for 220 volts d. c. Even if the instruments are not injured, there may still be enough of a shock to injure the operator or line workman temporarily, and it seems therefore not good policy to leave the entire protection to the device shown, and to leave out all other protective devices.—*Elektrotechnische Zeitschrift.*

PSYCHOLOGY IN ELECTRICAL ENGINEERING.

PROFESSOR DÜCK of the University at Innsbruck has a rather interesting article in the *Elektrotech. Zeit.* in which he discusses the need of applying psychological tests to engineers, and he takes up the question of the electrical engineer in particular. His article seems to offer some good suggestions for telephone exchange managers also, especially in regard to the fitness of candi-

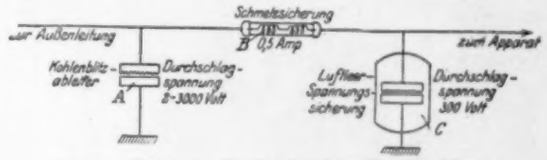


Fig. 7.—Protective Device for Low Tension Lines.

dates for positions, whether they be for telephone operators, linemen or telephone engineering itself. Aside from a physical examination which he advises should be given to all applicants, he devotes most of his time to the mental and psychic characteristics.

In the first place he takes up the eye and its lessons. He states that optical impression must call forth in the subject examined immediate responses, and from these it is possible to draw conclusions to the general fitness of the applicant. In testing the eye and the ear, the two organs used most of all, which applies especially to telephone operators, four memory tests were used, two optical and two acoustic impressions, each of them offering words and numbers. In addition concrete objects and colors were also used. It was found that, aside from the individual differences of subjects, women in general give better results in the field of purely productive measures. Of the 51 subjects examined, the majority had a better acoustic than visual memory. This may be accident, however, and allows no valid conclusion to be drawn.

The next test took up the testing of working rhythm and power of concentration. An unknown text was given each applicant and all *e's* were to be crossed out in a given limited time. After every 30 seconds, a signal was given, and the place marked. These tests were carried on for 5 minutes steadily. In figuring the results the amount covered per time unit was measured in terms of cm., the errors counted, and figured on the basis of 100 cm. Attention and speed have a definite relation to each other and must be used in this case. The capability of steady work, the attention, accuracy, speed and fatigue were

easily figured from these results, which were collected in graphic form. In this experiment outside disturbances were reduced to a minimum, and the next experiment was to tell what effect disturbances would have on the subject. Ten examples of the type: $17\times13+5=x$ were given and the normal time set at 2 minutes. The task was made difficult, however, by having the examiner figure entirely different examples in a loud voice and thus creating outside influences. The result was surprising, for several persons showed better results than obtained when working without outside influence. Probably their concentration in the first case was more marked due to an extra exertion of their will power. Here it showed also plainly what difference there is psychically between men and women. The subjects were between the ages of 17 and 20 and of the 22 men, only two failed in this concentration test, while 21 of the 29 women failed. Past experiments have shown that women are more susceptible to outside inuences, while men are more given to heed disturbances from within.

The test the individual differences as regards aspect within a small field two circles of different size and two squares, also rectangles in different positions were given to the subjects at intervals of two seconds, and they were asked to mark the center in each figure. The result showed greater accuracy on the part of the men.

To test the power of influence, passively, a sheet was given to each subject, and the same left in their possession for 3 minutes. They were told that they were to fix the details on the printed page in mind, so that they might use them in court if necessary. Then the sheets were removed and other tests undertaken. After 30 minutes the following questions were asked: (*A*) Was anything in heavy type and what? (*B*) Was anything in Latin type, and what? As a side question the examiner mentioned casually, that he meant the entire sheet, including the heading and the firm name of the advertisement, which would probably be in Latin type. The test was really based on the second portion only, for a good deal was printed in heavy type, but in Latin type were neither the heading nor the firm name, but only a small Latin proverb, in the middle of the reading matter. The result of the experiment showed that 5 men and 15 women were open to the suggestion by the examiner and set down what he suggested. Two men and three women answered that they had not seen anything of the matter asked. Entirely correct answers were given by only 2 men and 0 women. The result of the counter-suggestion was noticeable in 6 men and 3 women. Most of them answered only the question of the heavy print and left out the Latin. Finally the richness of ideas was tested by placing a large picture representing Menzel's painting, "The Rolling Mills" in the room, and asking the subjects, after they had studied the picture, to write down any ideas that were suggested to them by the picture. The results were very interesting and diverse. Men seemed to get hold of sociologal ideas, women more of ideas of emotion. Some answered by writing pages and pages of nonsense, others were short and to the point. It was also tried to test the perception of the subjects by asking them to study this picture carefully and then give a general outline of it, mentioning as many details as possible. Here again individual difference was brought out very prominently and some showed that they had good memories and were accurate, while others showed that their memory must have been wandering and had wrong impressions and mentioned things that were not in the picture at all.

While these tests are only a general outline, they show that the matter of selection of capability for positions is not the haphazard matter that it used to be and that we are beginning to co-ordinate science and practical every-day life, and are trying to fit every person where he belongs through his natural capacities and his training.

Sues Washington Telephone Combine

Charging the Pacific Telephone & Telegraph Company, the Sunset Telephone & Telegraph Company and subsidiary concerns in Washington and Oregon with combining in violation of the interstate laws to put the Northwestern Long Distance Telephone Company of Los Angeles out of business and destroy competition, John B. Coffey, receiver of the Northwestern has filed suit in the federal court at Tacoma, Wash., for $300,000 damages, through Attorneys Fulton & Bowerman, of Portland.

The complaint says the Northwestern company owned lines and franchises from Corvallis, Ore., to Multnomah, to Vancouver, Wash., thence to Kalama, Kelso, Tenino, Winlock, Centralia, Chehalis, Tacoma, Seattle, Port Townsend and Port Angeles, and had an arrangement for connection with the local telephone systems in Seattle.

On January 29, 1912, there was a suit pending in the circuit court at Portland, entitled the Title Insurance & Trust Company vs. the Northwestern Long Distance Telephone Company, the Home Telephone & Telegraph Company, and Charles E. Sumner, intervenor, to foreclose a mortgage on the Northwestern Company for the sale of its property in Oregon, according to the complaint, and Coffey was appointed receiver.

Mr. Coffey asserts the defendant companies entered into a combination in violation of the act of congress July 2, 1890. He names those entering the alleged combine as The Pacific Telephone & Telegraph Company, the Sunset and Pacific States Companies, William Mead, W. H. Allen, John F. Davies, Thaddeus S. Lane, the Home Telephone Company of Puget Sound, the Independent Company of Seattle, the Title Insurance & Trust Company, the Interstate Consolidated Telephone Company, the Independent Long Distance Telephone Company, the Granger Telephone & Telegraph Company, the McMinnville Local & Long Distance Telephone Company and the Lebanon Mutual Telephone Company, which he declared combined to wreck the business and properties of the Northwestern Long Distance Telephone Company.

He charges that in order to carry out the plan the Sunset Telephone & Telegraph Company purchased 4,212½ shares of the 6,291 shares of capital stock of the Northwestern Company and took control. It is alleged the Sunset Company also purchased title to $721,000 per value of mortgage bonds of the company with the understanding that the Title Insurance & Trust Company should cause the mortgage to be foreclosed, with the understanding that the Sunset Company was to bid on the properties and acquire title to them.

The complaint alleges the company had no local telephones in Washington, but arranged with the other companies named in the alleged combine to use their telephones, and that C. H. Judson, general manager of the Northwestern concern, from May, 1911, to November, 1912, caused the business to be handled as to further cripple the company and render it less liable to carry on its business. The complainant avers Judson had arranged to destroy his companys efficiency as a competitor of the other concerns.

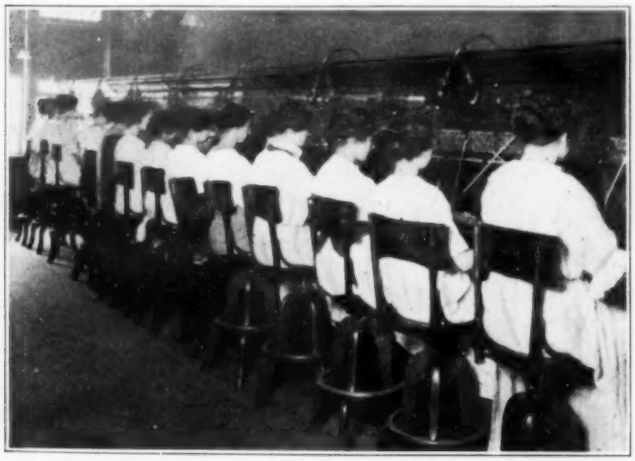
Corwin Semi-Automatic System in Operation

First Installation of the New Equipment at Fort Wayne, Indiana

ANNOUNCEMENT appeared in TELEPHONE ENGINEER for January, 1914, that the Home Telephone Company of Fort Wayne, Ind., was about to install a semi-automatic telephone system of the new Corwin type, manufactured by Frank B. Cook of Chicago. Early in the last month the installation was completed and the cut-over accomplished, so that Fort Wayne now affords the first and only example of the new system's operation. The equipment has been operating for nearly four weeks at the time this issue goes to press, under the supervision not only of the Home Company and the Frank B. Cook engineers, but of a number of other intensely interested telephone men, and has been entirely successful in every way.

The present equipment at Fort Wayne is in the South exchange, which has a mixed residence and business service to 1,500 lines. The large number of party lines in the district allows this plant to serve some 3,000 subscribers. The manual switchboard used to handle this business had 12 regular and two trunking positions equipped, and used 12 operators for the normal traffic. The first position of the board and the last three were blank, except for multiple jacks as usual. A slight rearrangement permitted the Corwin semi-automatic equipment to be installed in three blank positions, one in the last section and two in the preceding section. The three operators at these positions, one on incoming trunks and one at the emergency position, handle all the traffic—five operators as against 12 with the old equipment.

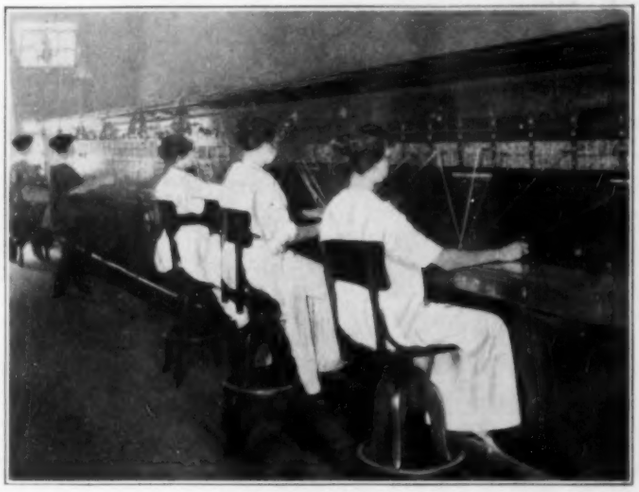
There are two exchanges in the Home Telephone Company's Fort Wayne system, "Main" and "South." The company's directory, however, does not indicate these



The Manual Board Before the Corwin Cut-Over.

exchanges by prefixing them to the subscriber numbers, the exchange being indicated by the first digit of the number. The result is that at present the calling subscriber gives the called number to the South exchange operator; if she trunks the call to Main exchange, the Main operator must ask for the number again. When the directory prefixes each number with its exchange name, as its next edition will, the South operator will trunk the call as soon as she hears the word "Main," and the subsequent part of the call, the number, will be received by the waiting ear of the Main operator. Since the trunking operation is instantaneous, no difficulty should be experienced in this action.

The 54 trunks from South to Main that were used with the old equipment have been reduced to 30, and a further reduction is probable. At Main exchanges the incoming trunk operators have been reduced from three to two. It is claimed that the transmission has improved more than 25 per cent on both trunk and local lines.



After the Corwin Cut-Over.

The South exchange chief operator's desk has mounted on its right hand panel six keys in three groups of two, each group supplemented by a supervisory lamp. By their means the chief operator can cut operators' positions out or in according to traffic, and determine the traffic by means of the lamps. Cutting out a position is done by breaking the ground connection. The desk is shown diagrammatically by Fig. 4.

In the terminal or switch room is the switch frame, in four bays. Line-finder and operator-finder switches are mounted on one side of the frame, cord and trunk switches on the other. The old intermediate frame remains with its connections, a wire being run from each terminal being run to the line side of the switch frame.

No appreciable trouble was experienced during or after the cut-over from manual to Corwin system, and the company, the operators and the subscribers are all well pleased with the success of what was to them, of course, an experiment—although the engineers responsible for the design of the new equipment were absolutely certain of its satisfactory performance.

In the Corwin system the circuits and apparatus are so designed almost all of the existing manual equipment of an exchange is retained in use. There is no change in the subscribers' equipment. At the exchange Corwin apparatus is added to the extent of approximately 20 per cent of the existing installation.

The function of the operator on a Corwin switchboard is merely to request the number called, plug into that number's multiple jack and press a button. That

is her whole cycle of operation. There are no answering jacks or plugs and no listening keys. The call comes directly to a waiting operator, and as soon as she presses the button she is ready for the next call, which in turn comes to her immediately. The button automatically sets up the proper connection and sends ringing current to the called station—or, if necessary, connects the busy-back. In either case, the disconnect is automatic and instantaneous. Meters show the number of calls for each group of 50 lines, as well as the number of cord and trunk connections in each position. The cycle of operations involved in any call may be understood by the following descriptions, aided by the Figures 1, 2, 3, 4 and 5:

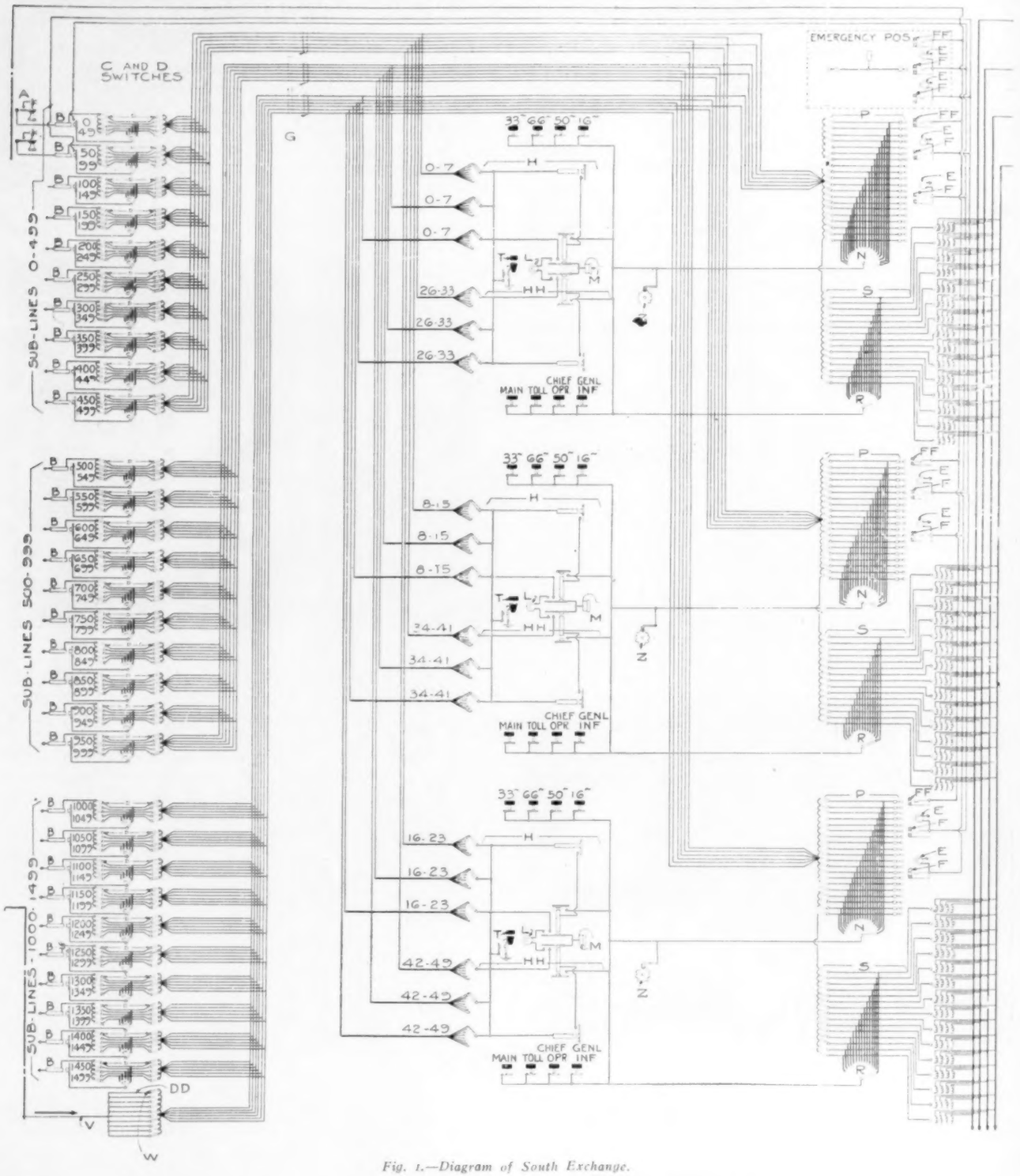


Fig. 1.—Diagram of South Exchange.

In the following circuit study reference is had to Fig. 1. Unusual efficiency in traffic distribution is obtained by the use of specially designed switches *D*, prop-

erly grouped, certain of these groups being controlled by a master switch *C*. All switches (except the selecting and connecting switches *SG* in the unattended subexchange, Fig. 3), have no normal position, being designed to move in one continuous direction and at a speed which allows the wipers to pass over thirty-two busy contacts and stop on an idle contact within one second.

The function of each master switch is to pre-select and maintain in waiting condition, one of the switch circuits or link connectors which it controls. As soon as this switch circuit or link connector is taken for use, the master switch immediately steps forward to the next idle switch circuit or link connector, thus maintaining the apparatus at all times in a waiting condition.

Each switch unit has, mounted at its lower left hand corner, a test jack. A test plug, common to all switch units, allows a test of the different circuits individual to each unit, to be made with one insertion.

The service is secret; the talking circuits being balanced, it will furnish any class of service and will operate in conjunction with any other type of apparatus. It permits the subscriber to quickly secure a connection; to instantly disconnect and secure another. This disconnect may be made in the middle of a conversation by either the called or calling party, as each subscriber has complete control of his line independently of the operator.

CALL FROM SUBSCRIBER IN SOUTH EXCHANGE TO ANOTHER IN SAME EXCHANGE.

A calling subscriber at station *A* initiating a call removes his receiver from the switch-hook, thereby closing the circuit through the line equipment *B*, which closes the circuit through the line lamp *E* associated with the calling line and the equipment in the master equipment *C* associated with the upper line and operator finder equipment *D*. The circuit established through the line lamp *E* and the master switch equipment *C* causes the upper left hand switch in the equipment *D* to move into connection with the contacts associated with the calling line *A*.

When this upper left hand switch has been brought into connection with the contacts of the calling line, they are arrested and the upper right hand switch belonging to the equipment *D* is caused to move into connection with an idle calling line extension G in an idle operator's position (in this instance, the calling line extension *G* connected to the uppermost contact of the upper switch *H* associated with the upper operator's telephone equipment *M*).

Switchboard Side of the Switch Frame. Rear of Fuse Panel at Right.

When the upper right hand switch belonging to equipment *D* is brought into connection with an idle calling line extension *G* in an idle operator's position, the switch is arrested in this position and the wipers of the master switch equipment *C* belonging to the line and operator equipment *D* are moved into connection with the next idle equipment *D*. The lamp *L* belonging to the upper operator's equipment *M* is now lighted, and the left hand uppermost switches belonging to equipments *P* and *S* are caused to move their wipers into association with the contacts belonging to the calling line extension *G* that has been selected by the calling subscriber *A*. The upper operator's telephone equipment *M* is also tele-

phonically connected with the calling subscriber *A*, and the operator learning the number of the desired line (in this instance the subscriber being another South exchange number), inserts the plug belonging to the uppermost cord link equipment *P* into the multiple jack *F* and presses that one of the four buttons common to her position, having the proper frequency for ringing the desired party's bell. When one of these buttons is depressed, the operator is immediately disconnected from the connection and the wipers of the upper switch *H*

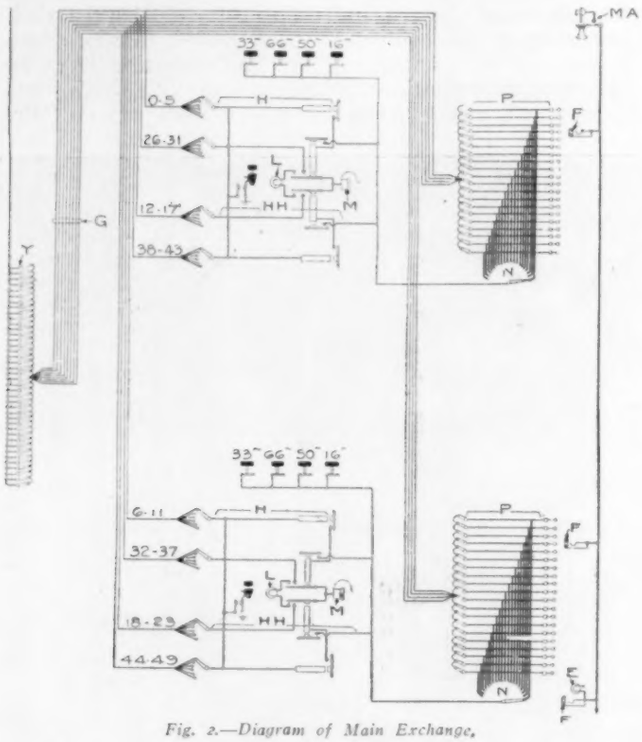


Fig. 2.—Diagram of Main Exchange.

are caused to move into connection with another idle calling line extension *G*.

If the called line is in an idle condition, the ringing induction will be transmitted to the calling party at station *A*, and upon the removal of the receiver at the called station the connection will be completed between the calling and called parties. If the called line is in a busy condition, the busy tone will be transmitted to the calling subscriber.

When the conversation is completed, the calling subscriber at station *A* upon placing the receiver upon the switch-hook, places his line equipment *B*, the switch equipment *D* and calling line extension *G* that was employed in this connection, in an idle condition. The called party placing the receiver upon the switch-hook restores his line equipment *B* and the employed cord link equipment *P* to an idle condition.

There are no disconnect signals associated with the cord link equipment *P*, and a plug can remain in a multiple jack *F* without interfering with other connections being made to that line, or with that line initiating other calls.

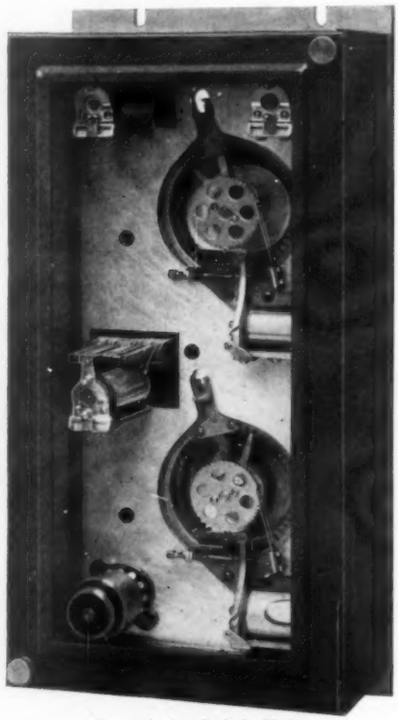
The calling and called parties have control of the connection, so that either of these parties can disconnect and initiate other calls independent of each other.

If the called line is busy, the calling subscriber at station *A* (upon obtaining the busy tone) would place his receiver upon the switch-hook, thereby restoring his line equipment *B*, the switch equipment *D*, calling line extension *G* and the cord link equipment *P* that was employed in this connection to an idle condition and ready for other use.

CALL FROM SOUTH EXCHANGE SUBSCRIBER TO SUBSCRIBER IN MAIN EXCHANGE.

Calling subscriber at station *A*, Fig. 1, initiating a call removes the receiver from the switch-hook, thereby closing circuit through the line equipment *B*, which closes the circuit through line lamp *E* associated with the calling line and the equipment in the master equipment *C* associated with the upper line and the operator finder equipment *D*. The circuit established through the line lamp *E* and the master switch equipment *C* causes the upper left hand switch in the equipment *D* to move its wipers into connection with the contacts associated with the calling line *A*. When this upper left hand switch has been brought into connection with the contacts of the calling line, they are arrested and the upper right hand switch belonging to the equipment *D* is caused to move into connection with an idle calling line extension *G* in an idle operator's position (in this instance, the calling line extension *G* connected to the uppermost contact of the upper switch *H* associated with the upper operator's telephone equipment *M*).

When the upper right hand switch belonging to equipment *D* is brought into connection with an idle calling line extension *G* in an idle operator's position, the

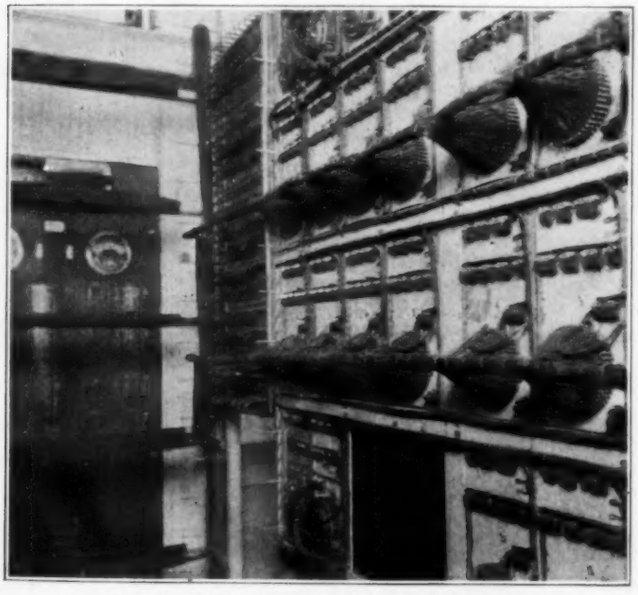


One of the Switch Units.

switch is arrested in this position and the wipers of the master switch equipment *C* belonging to the line and operator equipment *D* are moved into connection with the next idle equipment *D*. The lamp *L* belonging to the upper operator's equipment *M* is now lighted, and the left hand uppermost switches belonging to equipments *P* and *S* are caused to move their wipers into association

with the contacts belonging to the calling line extension *G* that has been selected by the calling subscriber *A*.

The upper telephone equipment *M* is telephonically connected with the calling line at station *A*, and the operator learning the number of the desired party (in this instance a party whose line terminates in the Main exchange) depresses the button marked "Main," belonging to his position, which disconnects the upper telephone equipment *M* from this calling line and causes the wipers of the upper switch belonging to equipment *H* to move into connection with an idle calling line extension *G*, and causes the upper right hand switch belonging to the upper trunk link equipment *S* to move its wipers into connection with an idle trunk line *X* terminating in a trunk switch *Y* located in the Main exchange, Fig. 2, whereupon the wipers belonging to the master switch equipment *R* belonging to the upper trunk link equipments *S* are caused to move into connection with the next idle trunk line equipment *S*. The wipers of the trunk switch *Y*, Fig. 2, belonging to the selected trunk line *X* are caused to move into connection with an idle calling line extension *G* in an idle operator's position (in this instance, the calling line extension *G* terminating in the uppermost contact of the upper switch *H* in the upper operator's position in the Main exchange). The lamp *L*, Fig. 2, is lighted, and the switch belonging to the uppermost cord link equipment *P* is caused to move its wipers into association with the selected calling line extension *G*. The upper operator's telephone equipment *M* in the Main exchange, Fig. 2, is now telephonically connected to the calling subscriber at station *A* in the South exchange, Fig. 1.



Rear View of Switch Frame, Showing How Cables Are Fanned.

The Main exchange operator learning the number of the desired station (in this instance, the station *MA*, Fig. 2), inserts the uppermost plug belonging to the cord link equipment *P* into the jack *F* belonging to the called station *MA*, and depresses that one of the four buttons having the proper frequency for operating the bell at station *MA*, and the depression of this button disconnects the telephone equipment *M* and causes the wipers of the upper switch *H* in the Main exchange to move into connection with an idle calling line extension *G*, and also the wipers of the master switch equipment *N* associated with the cord link equipments *P* in the Main exchange to move its wipers into connection with an idle cord link equipment *P*.

If the called station *MA*, Fig. 2, is in an idle condition, the ringing induction will be transmitted to the calling subscriber at station *A* in the South exchange, Fig. 1. When the subscriber at station *MA* removes the receiver from the switch-hook, the connection is established between the calling party at station *A*, Fig. 1, and the called party at station *MA*, Fig. 2.

Chief Operator's Desk Showing Switches.

When the conversation has been finished, the calling subscriber at station *A* upon placing the receiver upon the switch-hook, places his calling line equipment *B*, switch equipment *D*, calling line extension *G*, trunk link equipment *S* (all in the South exchange, Fig. 1), trunk line *X*, trunk switch *Y* and calling line extension *G* in the Main exchange, Fig. 2, in an idle condition and ready for other use.

When the called party at station *MA* places the receiver upon the switch-hook, his line equipment (not shown) and the employed cord link equipment *P* in the Main exchange is placed in an idle condition and ready for other use.

There are no disconnect signals associated with the trunk link equipment *S* and the cord link equipment *P*, and a plug can remain in multiple jack *F* without interfering with other connections being made to that line, or with that line initiating other calls.

If the called station *MA* had been in a busy condition, the busy tone would have been transmitted to the subscriber at the calling station *A* in the South exchange, and the subscriber upon placing the receiver upon the switch-hook would have placed all of the equipment used in establishing this connection, including the cord link equipment *P* in the Main exchange, in an idle condition and ready for other use.

CALL FROM SUBSCRIBER IN SOUTH EXCHANGE TO SUBSCRIBER IN UNATTENDED SUB-EXCHANGE.

Calling subscriber at station *A* in the South exchange, Fig. 1, upon removing the receiver from the switch-hook, will operate his line equipment *B* and the uppermost switch equipment *D* to select an idle calling extension *G* in a manner previously explained.

When the operator has become telephonically connected with the calling subscriber at station *A*, as has

been explained, and learns the number of the station wanted (in this instance station *SA*, located in the unattended sub-exchange, Fig. 3), the operator will insert the plug belonging to the uppermost cord link equipment *P* into a trunk jack *FF*, first testing these jacks *FF* to determine whether the trunk line is free for use, this testing being done in a manner well-known to those skilled in the art, and when the plug is inserted into the selected idle trunk jack *FF*, the operator will operate

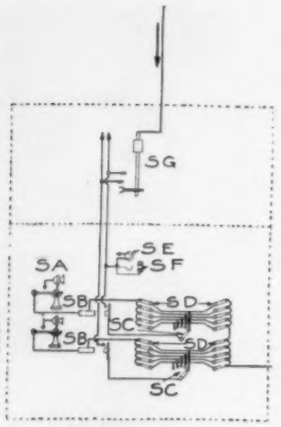


Fig. 3.—Diagram of Unattended Sub-Exchange.

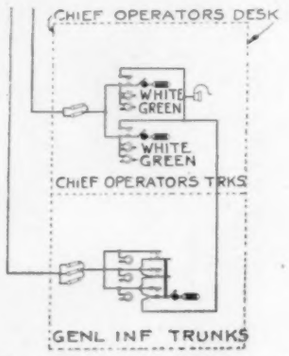


Fig. 4.—Diagram of Chief Operator and Information Desk.

the dial equipment *Z* to cause the wipers of the connector switch *SG*, Fig. 3, to be placed into connection with the contacts belonging to the line associated with station *SA*; this all being done in a manner well known in standard automatic practice.

When the connector switch *SG*, Fig. 3, has had its wipers placed in connection with the contacts belonging to the desired line, the operator depresses that one of the four buttons having the proper frequency, and when this button is depressed the operator's telephone equipment *M*, Fig. 1, is disconnected and the wipers of the employed switch *H* are caused to move into connection with another idle calling line extension *G*, and the wipers belonging to the master switch equipment *N* associated with the cord link equipment *P* are caused to move into connection with another idle cord link equipment *P*.

If the desired line is in an idle condition, the ringing induction will be transmitted to the calling party at station *A*, Fig. 1, and when the party at station *S*, Fig. 3, removes the receiver from the switch-hook, the connecnection is telephonically completed between the calling party at station *A* and the called party at station *SA*.

The talking and ringing current for the party at station *SA* is furnished from a cord link equipment *P* in the same manner as is furnished to a party whose line terminates in a jack *F*.

When the conversation is completed, the subscriber at station *A* placing the receiver upon the switch-hook places his line equipment *B*, the employed switch equipment *D*, calling line extension *G* located in the South exchange, in an idle condition and ready for other use.

The called party at station *SA*, placing the receiver upon the switch-hook places his line equipment *SB*, and the employed cord link equipment *P* in an idle condition ready for other use, and also restores the connector switch *SG* to its normal position.

Calling and called parties can disconnect an established connection of this kind and initiate other calls independent of each other.

If the called party at station *SA* had been in a busy condition, the busy tone would have been transmitted back to the calling party at station *A* in the South exchange, and when this party places their receiver upon the switch-hook the calling line equipment *B*, employed switch equipment *D*, calling line extension *G* and cord link equipment *P* would be placed in an idle condition and ready for other use, and the connector switch *SG* restores to its normal position.

CALL FROM SUBSCRIBER IN UNATTENDED SUB-EXCHANGE TO SUBSCRIBER IN EXCHANGE WITH WHICH UNATTENDED SUB-EXCHANGE IS ASSOCIATED.

Calling subscriber at station *SA*, Fig. 3, removing the receiver from the switch-hook operates the line equipment *SB*, completing a circuit through the line lamp *SE* and master switch equipment *SC*, this circuit causing the uppermost left hand switch of equipment *SD* to move its wipers into conection with the contact belonging to the calling line equipment *SA*.

When the upper left hand switch belonging to equipment *SD* is brought into connection with the contact belonging to the calling line, the upper right hand switch belonging to equipment *SD* is caused to move its wipers into connection with an idle trunk line *V* terminating in a trunk switch *W* located in the branch exchange (in this instance the South exchange, Fig. 1). Whe nthe wipers of the upper right hand switch are brought into connection with an idle trunk line *V*, the wipers belonging to the master switch equipment *SC* are caused to move into connection with another idle switch equipment *SD*. The wipers of the selected trunk switch *W* in the South exchange, Fig. 1, are moved into connection with an idle calling line extension *G* in an idle operator's position (in this instance the calling line extension *G* terminating in the uppermost contact of the third switch from the top *H*).

When the switch *W* is arrested in connection with this calling line extension *G*, the upper lamp *L* is lighted, the uppermost switches belonging to the cord link equipment *P* and trunk link equipment *S* are caused to move their wipers into association with the selected calling line extension *G*, and the upper operator's telephone equip-

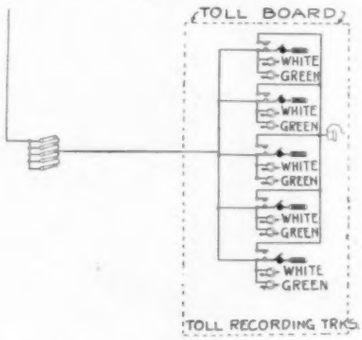


Fig. 5.—Diagram of Toll Board.

ment *M* is telephonically connected with the calling line equipment *SA*.

The operator learning the number of the desired party (in this instance the line associated with station *A* in the South exchange) inserts the plug belonging to the uppermost cord link equipment *P* into the jack *F* and depresses that one of the four buttons having the proper ringing frequency. The depression of this button disconnects the operator's telephone equipment *M* and causes the wipers of the master switch equipment *N*

belonging to the cord link equipments *P* to move into connection with another idle cord link equipment *P*.

If the called line equipment associated with station *A* is in an idle condition, the ringing induction is transmitted to the party at station *SA*, and upon the removal of the receiver at station *A* connection is established between the calling party at station *SA* and the called party at station *A*.

Upon completion of the conversation, the party at station *SA*, placing their receiver on the switch-hook places his line equipment *SB*, employed switch equipment *SD* located in the unattended sub-exchange, trunk line *V*, trunk switch *W*, calling line extension *G* located on the South exchange, in an idle condition and ready for other use.

When the receiver at station *A* is placed upon the switch-hook, the called line equipment *B* and the employed cord link equipment *P* is placed in an idle condition and ready for other use.

If the called line at station *A* had been in a busy condition, the busy tone would have been transmitted to the calling subscriber at station *SA*, and upon placing the receiver upon the switch-hook at station *SA*, the calling line equipment *SG*, employed switch equipment *SD* located in the unattended sub-exchange, trunk line *V*, trunk switch *W*, calling line extension *G* and cord link equipment *P* would be placed in an idle condition and ready for other use.

Calls to the chief operator, general information and toll board are transferred in the same manner as explained on the call from the South to the Main exchange; that is, the operator will depress the proper one of the four buttons marked "Main," "Toll," Chief Operator" and "General Information" depending upon where the call is to be transferred, and the depression of either one of the three buttons marked "Toll," "Chief Operator" and "General Information" will light a lamp on an idle trunk line terminating at the toll, chief operator or general information positions.

The buttons marked *"T"* in the operators' positions are used for the purpose of spotting the lines; that is, when a calling subscriber is connected with an operator's telephone equipment *M* and the operator desires to learn the number of the calling line, she will depress the button *T*, which will cause the lamp *E* (individual to the calling subscriber) to light intermittently before the emergency position, and this operator will insert a plug, in the usual practice, into the multiple jack corresponding to the lamp lighted, and will obtain from the operator necessary information for completing the connection or reporting trouble on the line.

METHODS USED FOR HANDLING EMERGENCY CALLS, TROUBLES ON LINES AND CABLES, ETC.

In this system each line is provided with an individual lamp, located before a group of operators known as emergency operators. If the five switch equipments *D*, Fig. 1, associated with a particular group of fifty lines are busy, additional calls coming into this group of fifty lines will light their individual line lamps *E* in addition to a special pilot lamp associated with this particular group of fifty lines, and this pilot lamp will not light unless the five switch equipments *D* in this particular group of fifty lines are busy. A lighted lamp *E* in connection with its associated lighted pilot lamp, informs the emergency operator to answer these calls, which she does in the usual standard manual practice by inserting an answering plug into the jack associated with the lighted line lamp, and she completes the connection with a connecting plug in the usual manner.

In the event of a grounded or shorted line causing the switch equipment to operate, so as to connect an operator's equipment *M* with this line, the operator will depress the key marked *"T"* in her position, which will intermittently light the line lamp *E* individual to this calling line, and the emergency operator upon inserting the answering plug into the jack associated with this line lamp, will obtain the necessary information from the operator as to the condition of the line, and will handle the connection in accordance with rules of the traffic department.

In the event of a large number of permanents in a particular group of fifty lines, caused by defective cables due to burn outs or moisture, the lamps *E* individual to the lines in this particular group of fifty lines will be lighted, five of these calls being taken care of by way of the switch equipments *D*. The emergency operators upon noting the lighted lamps *E* in connection with the pilot lamp associated with this group of fifty lines, will plug out these calls in the same manner as is done by hospital operators in common battery manual practice.

Means are provided for taking care of troubles, emergency calls, etc., to enable the operator to obtain the number of the calling lines and take care of the troubles in the same manner as is done in common battery manual practice, by means of hospital operators.

After the cut-over it was found that the operators assigned to the Corwin positions, although of course new to the work, were able to handle calls at a rate as high as 840 per hour. This figure is expected to reach 900 or 1,000 with experience.

This description of the installation and operation of the Corwin system in The Home Telephone Company's South exchange at Fort Wayne will be followed by an article which will study the traffic statistics developed by the engineers who have been studying the operation of the equipment.

Discusses Service in England

Referring to the postmaster-general's statement in the English Parliament that inquiries had been made of 135,000 telephone subscribers in London, and 128,000 replied, 87 per cent of whom reported that the service was perfectly satisfactory, C. E. Goldman, chairman of the Parliamentary Telephone Committee, has written to the press pointing out that the inquiries were purely verbal, and were limited to the question: "Is your line working all right?" He himself had answered the question in the affirmative, not knowing that it represented a formal inquiry as to the efficiency of the service as a whole. On the other hand, his committee had circulated forms containing 24 questions to 2,500 of the largest telephone users in London, and of the 1,000 replies already received, not ten expressed satisfaction with the service. The whole profit on the telephone system, he says, is now less than the royalty paid by the National Telephone Company to the State before declaring its dividend of 6 per cent.

The Finance and General Purposes Committee of the Bradford Corporation decided to summon a conference of corporation representatives on telephone advisory committees in Leeds, Halifax, Sheffield, Huddersfield and Bradford, to consider a scheme under which those municipalities should take over complete control of the telephone services in their areas.

Damage to Cables by Stray Railway Currents

Mitigating Electrolysis by the Insulated Return Feeder System

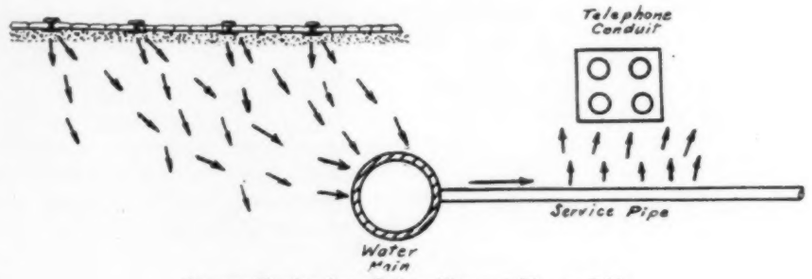
BY FRANK C. PERKINS

RECENTLY city ordinances have been enacted in American cities for the purpose of protecting underground structures from injury by electrolysis due to stray electric railway currents where grounded returns are used. These ordinances require in general that the metallic conductors for the railway return circuit be insulated from the ground, as far as possible; that 7 volts be taken as the average overall voltage drop in the tracks for any ten minute interval and that during such interval the average potential gradient in any 1,000 feet shall not exceed one volt.

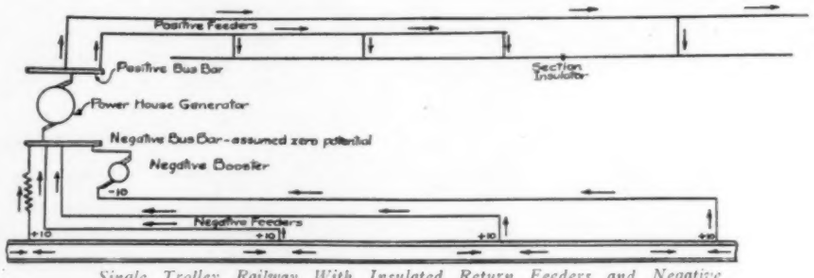
Pilot wires are urged for determining the voltage drop, these pilot wires having been required by the Board of Trade regulations of England for two decades for providing continuous records of track voltage drop. The same is required in Germany.

The electrolysis ordinance of Chicago provides for a division of the city into three zones, with permissible differences of potential of 10, 15 and 20 volts respectively, all uninsulated electrical return circuits to be of such current carrying capacity and so arranged that the sustained maximum difference of potential between any two points on any uninsulated portion of the circuit shall not exceed the limit of 10 volts in the inner zone.

This ordinance followed water waste surveys in charge of Chicago City Engineer John Ericson and electrolysis report by Engineer Ray Palmer, citing damage to water pipes, cable sheaths, gas pipes, structural steel buildings and steel bridges. He pointed out that electrolysis damaged service pipes and mains resulting in high maintenance costs and large annual loss due to leakage. He maintained that the lead sheathed cables of the city police and fire alarm systems, telephone, lighting and power companies were being seriously damaged in various parts of these electrolysis surveyed districts. Records of tests taken on the Van Buren, Wells, Clark, Dearborn, State, Adams and other bridges showed that most of the bridge steel structures carried considerable amounts of stray railway current, over one hundred amperes flowing from the box girder in the center of the Van Buren street bridge on the west end of the car tracks, and he held that a maximum drop of 10 volts was obtained at this point with the steel work positive to the rails and the steel columns badly corroded at the base making repairs necessary.



Current Flowing from Rail to Pipe and Pipe to Cable



Single Trolley Railway With Insulated Return Feeders and Negative Booster, Showing Path of Currents and Typical Rail Potentials.

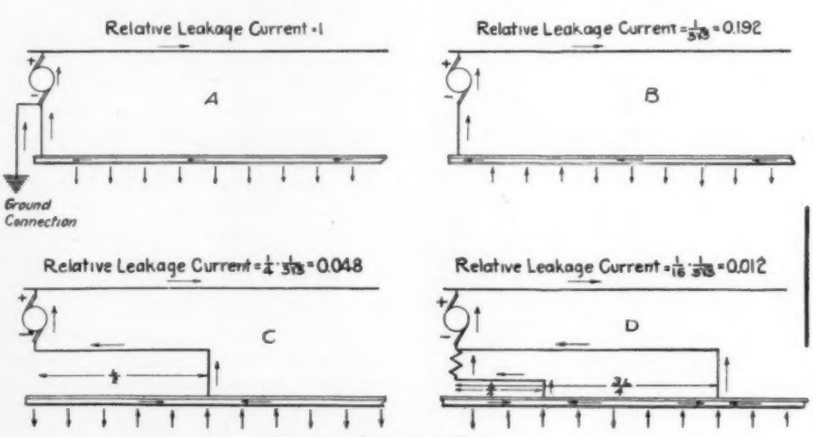

LEAKAGE CURRENT WITH BUS-BAR GROUNDED AND WITH NO RETURN FEEDER. COPPER = $\frac{e I L^2}{35,000}$ (ASSUMED UNITY)
Relative Leakage Current = 1
A
Ground Connection
Relative Leakage Current = $\frac{1}{513}$ = 0.192
B
Relative Leakage Current = $\frac{1}{4} \cdot \frac{1}{513}$ = 0.048
C
Relative Leakage Current = $\frac{1}{16} \cdot \frac{1}{513}$ = 0.012
D

Diagram of Leakage Current.

Unprejudiced work is absolutely essential, and it is therefore a great satisfaction to know that the Bureau of Standards of the Department of Commerce at Washington, D. C., has made and is making electrolysis surveys in various American cities, one of which has recently been completed for the city of Springfield, Mass., which was undertaken at the joint invitation of the water department of the city, the telephone company, the gas company, and the telegraph company, with the co-operation of the electric railway company, although it did not join in the original invitation.

The Bureau of Standards is making a study in Hollywood, Cal., a suburb of Los Angeles, with the co-operation of the water company and two railway companies for the

purpose of arriving at a method of correcting the electrolysis troubles that will be mutually agreeable to all the interests concerned including the railways which cause the trouble.

A statement from the standpoint of a municipality is of interest as made by Mayor Charles E. Tucker of the city of Elyria, Ohio, in which he says that "the Bureau of Standards has furnished to this city a very complete electrolysis survey which seems to indicate very conclusively that when certain changes and improvements are made by the electric lines in this city, conditions will be materially improved. No action has been taken as yet with reference to correcting the trouble, but engineers for the electric lines are of the opinion that when the changes are made it will result in a considerable saving to the companies as well as afford protection to the water and gas pipes. The situation in many places was found to be serious and showed that something must be done to prevent a considerable loss to our water system."

The following statement from the standpoint of the United Railways Company of St. Louis is of interest as made by Assistant General Manager Richard McCulloch: "At the suggestion of the Bureau of Standards we equipped a new substation, which we were building about a year ago, with their system of insulated return feeders. This system has given excellent results. It has been examined while in full operation, both by the Bureau of Standards and by Professor Ganz, representing the telephone companies. Neither found any danger of electrolysis from the return current. It is my opinion that a new substation, where new copper is installed, can be put in just as economically with this system as with any other, and with less danger from electrolysis. It would, however, be an expensive matter to adapt an old substation or power station, having copper buried in the ground, to this system."

The tests made at St. Louis on the insulated return feeders system for mitigating electrolysis, according to Prof. Albert F. Ganz, indicate that there is no doubt that "it is feasible by means of a small number of insulated return feeders to bring about an approximately constant potential condition over a large area and to reduce the drop in the tracks, and therefore in the earth, to values which experience has shown afford a substantial measure of protection from injury by electrolysis to underground structures."

These results have been attained at an initial cost which cannot be considered large, and at an annual cost which is small in comparison with the benefits derived. It is vital to the successful operation of the insulated return feeder system, as well as of any other system of electrolysis mitigation, that the rail bonding be kept in good repair.

It has been pointed out by Prof. Ganz that "it has been assumed by some writers in the past that no corrosion from electrolysis can take place if the voltage between two metallic conductors in soil such as between pipe and rails, is less than 1.5 volts, because this is the dissociation voltage of water. This, however, is entirely wrong, and it has proven by investigations and is now generally recognized that the amount of corrosion produced by electrolysis is independent of the voltage, except in so far as this determines the amount of current flowing, and that the smallest fraction of a volt can produce corrosion from electrolysis under suitable conditions."

He states that "besides danger from electrolytic destruction of the pipes, stray currents where they flow on underground piping systems frequently enter buildings through service connections and produce a serious fire hazard. For example, current may flow into a building through a water service pipe, then flow from the house water piping to the house gas piping, and then out from the building through the gas service piping. Such contacts between service pipes or between a service pipe and the lead sheathing of a telephone or a power cable frequently occur through metal ceilings, or where the pipes rest against each other. Dangerous heating may be produced where the current flows through such contacts; or where vibration may momentarily separate the contacts and produce an arc, nearby inflammable material is in danger of being set on fire." Professor Ganz says, "he has found many cases where currents up to 30 amperes were flowing into and out of buildings through service pipes or lead cable sheaths. Evidence of arcing having occurred between such contacts in buildings have also been found. There is no doubt that many fires have started in this way."

In tests made of electrolytic corrosion of iron in soils by the physicists Burton McCollum and K. H. Logan of the Bureau of Standards "these results show quite clearly that there is no reason except that the corrosion efficiency changes materially at any critical value of voltage within a range that is of any practical consequence in the negative return of street railway systems." It is stated that "efficiency of corrosion was found not to be a function of the voltage except in so far as the current density may be affected. Voltages as low as 0.1 and 0.6 volts showed practically the same efficiency of corrosion as 5 to 10 volts higher."

Similar tests were made by these experts on the surface insulation of pipes, and the conclusions indicate that pipe paints, dips and wrappings with practically no exception are of no value whatever for protecting pipes from electrolysis when applied in the positive areas near the power house. If, however, they are applied in negative areas they may be of considerable temporary value in reducing the current picked up by the pipe and in that way indirectly they may reduce damage in positive areas."

In the studies in electrolysis mitigation in Springfield, Ohio, made by E. B. Rosa, chief physicist and Burton McCullum, associate physicist of the Bureau of Standards, they maintain that it was found that those methods which are intended to be applied to the pipe system are regarded as unsatisfactory in general, and particularly so for conditions as they exist in Springfield. This is the more emphasized by the fact that there are in the pipe systems at Springfield, especially the gas system, a considerable number of insulating joints, "the gas company, we are informed, having several hundred Dresser couplings scattered throughout its system.

"So long as these insulated couplings are placed the application of negative feeders to either the gas pipes or the water pipes, or to both, would prove disastrous to the gas system in the vicinity of these insulating couplings. On the other hand, if the system of insulated negative feeders be applied to the tracks as recommended in the report so that the potential difference between parts of the networks are reduced to comparatively low value, the pressure of the insulating joints would be decidedly beneficial since they would tend still further to reduce the current in the pipes, while the potential gradients would be so small that dangerous potential drops across the insulating joints could not arise. The life and property hazard would also be increased by the installation of a system of feeders connected to the pipes, because of the dangers from fires and explosions already pointed out

in this report." After a full consideration of the merits of all the different systems available, they strongly recommend that the insulated negative feeder system applied to tracks be adopted as the primary means of electrolysis mitigation in the city of Springfield. As a result of experimental test on a system of insulated negative feeders in St. Louis, Electrolysis Experts Rosa, McCollum and Logan of the Bureau of Standards came to the conclusions that "for substantially the same installation cost, very much better electrolysis conditions can be secured with insulated negative feeders than with uninsulated feeders. When the potential differences in the track return are reduced to the low values that can readily be obtained by means of insulated negative feeders, the tying in of the pipes to the tracks has a much smaller tendency to cause heavy current flow in the pipes than if such reduction of potential differences is not realized. Where good voltage conditions in the negative return are maintained, the insulated feeder system can be in most cases installed so as to yield far greater economies both in installation and operation costs than is possible with uninsulated feeders. In the case of old stations in which there is already a large amount of negative copper installed in such a way that it is impracticable to insulate it, the insulated feeder system would still be economical in case it is desired to lower potential difference in the negative return below those at present existing. Wherever such reduction of potential differences is contemplated the insulated feeder system will show the same marked economy over the insulated system as is shown in the case of new stations. Negative feeders which are so laid that they can not be insulated will not be used any less efficiently if supplemented by insulated feeders than if uninsulated feeders are added, provided equally good voltage conditions in the track are maintained in both cases. The opinion that such uninsulated copper is largely wasted if supplemented by insulated feeders is therefore evidently based on a misconception.

Uninsulated negative feeders are always wasteful wherever good voltage conditions in the negative return are required and any addition to such uninsulated feeders is an extension of this waste. This can be avoided by using insulated negative feeders for all extension work.

"As to the relative cost of insulated and uninsulated feeders for the same voltage conditions, it is stated that for the same voltage conditions it would require 9.16 times as much copper for the uninsulated feeder system as is required in the present insulated system. Since the cost of the present system is $25,500, the cost of the uninsulated system using the same unit cost would be 9.16 times as great, giving a total of $233,580, which is $208,080 in excess of the total cost of the present insulated feeder system, and figuring as before 10 per cent as the annual cost on the copper installed, we get $20,808 a year as the excess annual charge on the investment in uninsulated feeders. If such a system were installed, however, it can be shown that it would reduce the potential drop in the negative return to about two volts, which would be a reduction of 17 volts below that which prevails at the present time, which corresponds to an annual saving in energy of 521,220 kilowatt hours, which is worth $5,212 at one cent per kwh. Deducting this from the annual charge on the copper we get a net anual charge on the uninsulated feeder system of $15,596 in excess of the annual charge on the present system. While of course it does not follow that if the uninsulated system were to be installed the location of the feeders would be just the same as here assumed, the assumption is nevertheless approximately true and the estimated costs are of the correct order of magnitude and they show the impossibility, from an economic standpoint, of securing with the uninsulated feeder system approximately the same voltage conditions as can be obtained with a system of insulated feeders.

"When the advantages from both the electrolysis and economic standpoints are fully weighed it seems rather surprising that insulated feeder systems have not been more widely used in the past, and when the advantages are fully appreciated such systems will be adopted as the standard of practice to the practical exclusion of uninsulated feeders except in special cases where the load is so light that neither electrolysis conditions nor economic considerations require additional conductivity over that furnished by the tracks themselves."

From the tests made in the various American cities and the result shown where insulated return feeders have been utilized, this system has been found practical and effective for the mitigation of electrolysis troubles due to stray electric railway currents.

Foreign Talk on Party Lines

The following interesting item is from the Sarcoxie *Record* and states that a situation which is proving serious to the operators of the Carthage, Mo., phone company and which may lead to unprecedented complications has arisen south of town, where a number of German citizens have developed a habit of talking in their native tongue when communicating with each other over the line. This has proved to be a convenience to them, but to some of those on the same line who cannot understand German, the sonorous gutterals which assail their ears, on the occasions when they take down the receiver to learn the news, have had a very disturbing effect.

Complaint has been made to H. B. Boyd, president of the company, that the usefulness of the telephone line as a distributor of local news has been materially impaired by this habit of the Germans and Mr. Boyd does not know exactly what to do about it. Obviously he can not dictate to telephone patrons regarding the tongue to be used in telephone conversations. He is therefore thinking of opening a school of German for patrons of the line so that they may be able to interpret the language of the fatherland.

The only thing which keeps him from definitely deciding on this course is that it may establish a precedent which may lead the company into a maze of complications. There are a number of Irish patrons on the line and if these should follow German example and talk over the telephone in the language of "The Ould Sod," the company would feel compelled to follow precedent and establish a school for instruction in Gaelic. This would be a rather difficult undertaking as there are very few professors of Gaelic languages in this country.

The difficulty might be overcome to some extent by providing patrons with German dictionaries, but this would be only a partial remedy. Moreover, there is no German equivalent for the word, "hello." The nearest approach to that word in German is "he du," or "wegehts."

Possibly the thing may be arbitrated or maybe a "central" will be established to act as interpreter. The situation is a very delicate one and some action must be taken soon, else the non-German patrons who acquire local information via the telephone receiver may resort to military tactics.

The Telephone Scrap Book

Curious and Useful Items, More or Less Telephonic, Gathered from Everywhere

Simultaneous Telegraphy and Telephony

A DESCRIPTION of some recent telephone experiments made by me on our lines may be of interest to your readers. I do not know whether these ideas have been exploited before, but I have never seen anything just like them, says J. P. Church, superintendent of telegraph, Wabash Railroad, Decatur, Ill., in *Telegraph and Telephone Age*.

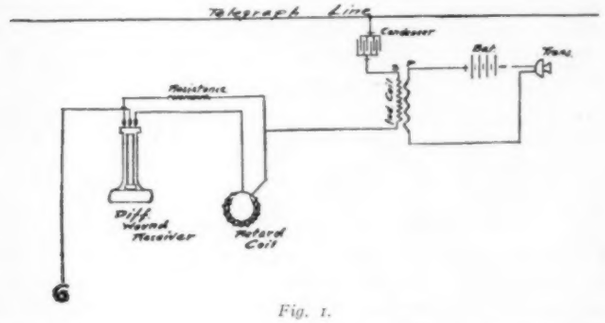


Fig. 1.

In the arrangement shown in Fig. 1, my idea was to use a differently wound telephone receiver to neutralize the disturbance caused by the telegraph battery and induction from other wires, and thus eliminate the noise from the receiver. By inserting a retardation coil in one coil of the receiver to force the telephone currents through the other coil, so the talk would be heard and a non-inductive resistance in the other telephone coil to balance resistance of the retardation coil, I was able to reduce the noise in the receiver so that perfect talk resulted. A high resistance retardation coil and non-inductive resistance could be used by bridging the non-inductive resistance with a condenser which would pass the telephone currents around the resistance.

The transmitter circuit is the same as that of any telephone, and connection to line was made through a condenser in the usual manner. The regular howler call can be used with this arrangement.

In Fig. 2 I used two induction coils instead of the condenser and retardation coils and non-inductive resistance; also a common telephone receiver, instead of winding the coils differently. The primary of the induction coil used for receiving and the secondary of the coil used to talk out are inserted in the telegraph line the same as an ordinary relay, while the receiver is connected to the secondary of coil 1, and the transmitter to the primary of coil 2. This arrangement makes a first-class composite circuit, and there is not an excessive amount of noise in the receiver. This may be eliminated by bridging the receiver terminals with a retardation coil, without materially reducing the transmission.

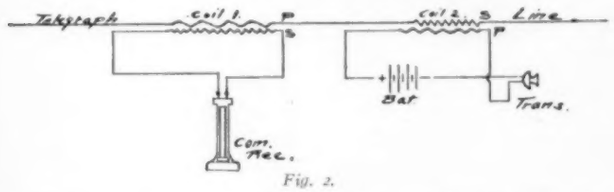


Fig. 2.

Both arrangements talk over into our dispatcher's telephone circuits, which are next to the wire upon which the experiments were tried between Decatur and Forrest, a distance of eighty miles. This cross-talk does not bother the dispatching circuits materially, but the talk can be heard when they are quiet. It might be reduced by placing retardation coils at Forrest and Decatur. We do not hear the talk from dispatching circuits in the composite telephone.

In the arrangement shown in Fig. 3, I am using one coil wound with three wires, the primary next to the core; one ohm resistance, line coils over the primary fifty ohms, and the secondary over line coil 500 ohms. My idea was to reduce the current on line to prevent cross-talk and then multiply in the receiver to insure good transmission.

This arrangement talks somewhat stronger than that shown in Fig. 2, but it is necessary to open the home-receiver circuit by means of a push-button switch when talking, to overcome the reluctance of the coil when the secondary is closed. The cross talk appears to be somewhat reduced by the lower capacity of the line coil.

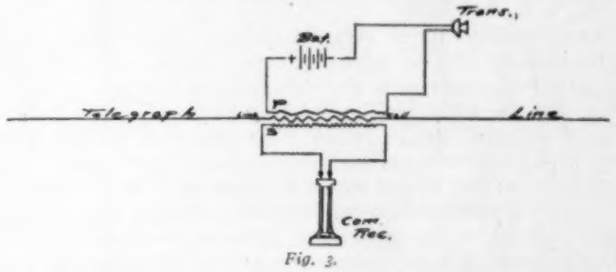


Fig. 3.

Colin-Jeance System of Radiotelephony

THE continuous waves employed in this system are produced by three arcs connected in series, each arc having a carbon and copper electrode. The carbon electrode is of about 1.5 mm. in diameter and is attached to the negative pole. The copper positive electrode is in the form of a disc; this disc is very easily replaced and forms part of the base of a cylinder filled with paraffin and cooled by water circulation.

The arcs are "struck" in an atmosphere of carburetted hydrogen gas, which may, for example, be produced by mixing in correct proportions acetylene gas generated from calcium carbide and hydrogen generated from calcium hydride.

This process is carried out in a single generator, the gases being produced very conveniently in the correct proportions, and the result of burning the arcs in this atmosphere prevents any burning away of the carbon electrodes; in fact, they actually slightly increase in length. The arcs are controlled by separate regulators to keep the distance of the electrodes constant. Owing, however, to the comoposition of the gas in which they burn, only very slight variation occurs, so that the use of this hand control regulator is not really necessary.

The supply voltage from the dynamo may be varied by shunt regulation from 500 to 750 volts, the current

consumed varying from 3½ to 4½ amperes. From the diagram it will be seen that the current is led through choking coils and a steadying adjustable resistance. The voltage at the terminals of the three arcs in series, where the oscillatory circuit is tapped off, is from 250 to 350 volts. When the oscillatory circuit is broken in passing

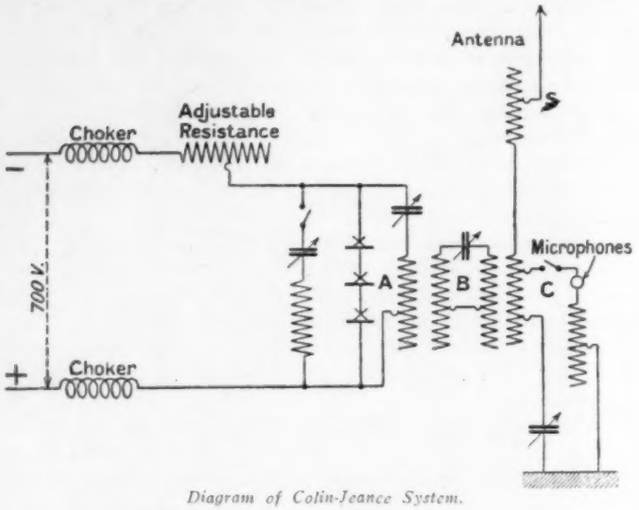


Diagram of Colin-Jeance System.

from transmission to reception, this voltage falls to approximately 150 volts, and a resistance is automatically inserted to compensate for this drop in voltage.

The principal oscillatory circuit consists of an inductance and variable condenser *A* connected in parallel with the arcs. An intermediate oscillatory circuit *B* consisting of an inductance and variable condenser is utilized to couple the principal circuit with the antenna and insures that multiple waves generated in the main circuit are not transmitted to the antenna, the result being that only a single wave is emitted.

The antenna circuit consists of an inductance coupled with the circuit *B* and a variable condenser. A variable self-induction is also used in the aerial.

The microphone circuit consists of nine carbon microphones connected in series and so arranged that they are all acted upon by the voice simultaneously by means of a megaphone. The microphones are connected between the variable inductance of the oscillation transformer and the earth as shown at *C* in sketch. This has the double advantage of avoiding sparking, such as always occurs in the microphones when they are placed directly in the antenna, and does not limit the antenna energy to that which can be taken by the microphones.

The station has two complete microphone circuits and two megaphones, a switch enabling one to change instantly from one to the other, so that the one not in use, should it become heated, has time to cool. In this way it is possible to talk continuously for an indefinite time without in any way overloading the microphones.

The station is also arranged for telegraphic transmission with a musical note, whose pitch may be changed at will. This is carried out by placing an oscillatory circuit having musical frequency across the arcs; this circuit consists of a condenser and variable inductance, the latter being changed by means of a multiple switch so that transmission may be carried out on any desired note. This arrangement is very valuable for transmitting messages during times of atmospheric disturbances. When employing this musical transmission signalling is carried out by cutting out the antenna.

All the transmitting coils consist of flat spirals of copper strip and the condensers are of the well-known glass plate type constructed by the Compagnie Générale Radiotélégraphique. The reception calls for no special comment, except that arrangements are provided for very exact tuning, C. G. R. variable air condensers being employed.

The wave-length of transmission can be readily varied between wide limits. From the official tests that have been carried out the following particulars are taken and will be of interest:

Supply voltage	650 volts
Supply current	4.2 amperes
P. D. across the arcs in series	350 volts
Antenna current	4.6 amperes
Antenna current with microphones in circuit	3.2 amperes
Current in the microphones	0.5 ampere
Wave-length	985 metres

With this system demonstrations have recently been carried out for the French Naval Authorities, and conversations have been carried on between Paris and Mettray, a distance of 200 km.

A Queer Use of Telephone Parts

THE accompanying photograph, which was sent to the *Western Electric News* from Galgary, Canada, shows an opium cup that was taken from a "dope" fiend in a recent raid in Calgary:

The entire cup was made up of parts of standard Western Electric telephone apparatus. The bowl of the cup is a bell top, taken from a ringer, and the supporting unit or foot is made from two transmitter adjusting nuts taken from a desk set.

Washington Restricts Use of Telephone

Gossiping and the playing of musical instruments for the benefit of subscribers will hereafter be prohibited on the telephone lines of the South Telephone Company, of Canyon City, Grant county, Wash., according to a tariff filed by the company with the State Railroad Commission. Though no explanation accompanied the tariff, it is presumed that the gossiping and playing of musical instruments were carried on to such an extent by the subscribers as to make its prohibition necessary.

The question of laying a telephone cable between Sweden and Germany has been under discussion for a considerable time, and the plan was approved by the authorities on both sides just before the war. The total expenditure in conection with the project is estimated at $180,000 of which sum each country, according to the agreement, agreed to pay half.

Telephone System on Electric Railway

ON the steel tower transmission lines throughout the system of the Georgia Railway and Power Company, a one circuit, two-wire telephone line is strung, connecting the power house at Tallulah Falls with all of the substations. This telephone line is constructed of No. 4 copper-clad steel wire, of 30 per cent conductivity, and the wires are strung on suspension type insulators of one unit each from the lateral tower bracing about ten feet below the lowest power conductor. By means of a specially designed clamp, hung from the insulator hook, the telephone wires are dead ended on each side of and transposed at every tower, the transposition being effected by crossing the loops in the two wires between the strain clamps on either side of the tower, one loop being given more slack than the other. This method makes it unnecessary to cut the wire and gives a thorough running transposition with the minimum number of joints. The wire is made from special large ingots so as to get lengths of one-half mile or longer. The required splicing is done by the use of 7½-inch copper sleeves. Mention is made of these facts for the reason that the essential points of a telephone system are high conductivity, small number of joints, and high insulation with balanced electrical characteristics. The large size of wire used also furnishes the mechanical strength necessary in stringing the wire with spans equal to the tower spacing to prevent excessive tension under severe load conditions due to ice and wind, says *Electrical Engineering*.

The standard telephone booths are located every

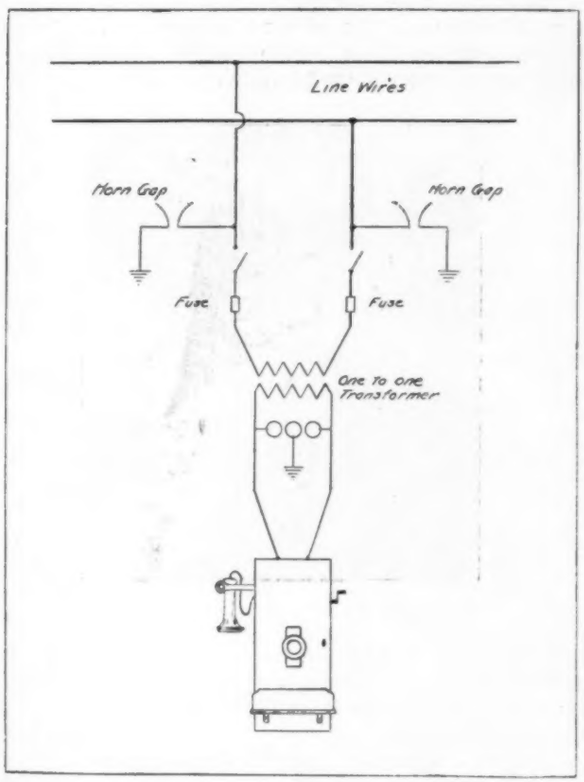


Fig. 1.—Telephone Circuits at Line Booths.

four miles along the line, or about every thirty towers. It is simply a frame building about 4 feet square, with a specially constructed 22,000 volt switch on the roof. This switch is made with horn gaps to ground set at approximately ⅜ inches, and the two poles operated simultaneously by means of a hand lever inside the tele-

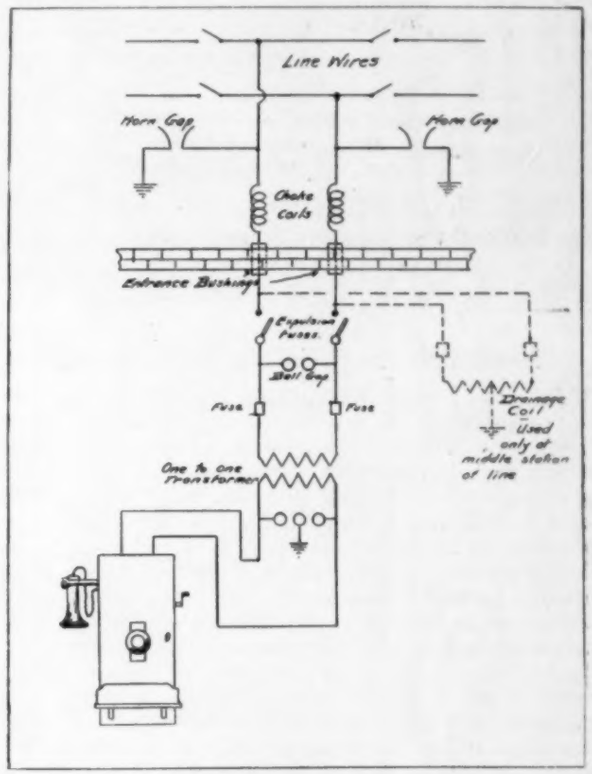


Fig. 2.—Telephone Circuits at Stations.

phone booth through a vertical pipe shaft. Inside the booth is an insulated platform, on which the operator may stand while closing the switch by moving the hand lever to the left, thus cutting the station in multiple with the line. As soon as he finishes his conversation, the switch is again opened, cutting the telephone from the line. It is apparent from the foregoing that the telephones in the booths along the lines are not connected to the line, except during the conversation.

Wireless Field Apparatus for French Navy

An article in the Paris *Matin* which has excited much interest refers to some interesting experiments in wireless telephony carried out by Captain Colin, of the Frency navy, who has been at work on the subject for some years in collaboration with Lieutenant Jeance. The details of the apparatus are not given, but it would appear that some improvement has been made in the direction of maintaining steady and continuous oscillations at the transmitting end. Speech, it is stated, has been transmitted from Paris to Finisterre, a distance of 300 miles, and a type of field apparatus with a mast about 90 feet high has, it is said, been developed, which can be unloaded from a motor-car and set to work by a crew of six men in twenty-one minutes, and will transmit without difficulty over a distance of from 60 to 120 miles.

That a man is successful in making money is no sign that he is looking for a chance to beat you out of a dollar.

An Electric Pole Truck Used in Philadelphia.

Novel Pole Truck in Use in Philadelphia

THE many obstacles confronting the transportation of large poles has led the Philadelphia Electric Company to adopt a new type of truck to relieve many of the trying situations that arise in narrow, congested streets. A horse-drawn vehicle that had been used had so many disadvantages in the haul of long poles in the matter of making a turn and in unloading, that it entailed a great amount of time, labor and expense. To bring these conditions down to a minimum and as near perfect as possible, a special truck was manufactured by the Commercial Truck Company.

This truck, now in use, seems to embody every detail hoped for and it has become a decided success in the handling of the long pole problem. The truck itself has a loading capacity of 6 tons and when unloaded weighs close to 12,000 pounds. The wheel base is 20 feet and its length over all exceeds 30 feet. To provide as limited a turning radius as possible it has been equipped with portable rear wheels operated by means of a steering gear on the side, which, when the wheels are neutral and in the same place as the front wheels, automatically closes and the truck is guided entirely by the front steering wheel. That the greatest amount of traction possible might result the truck was equipped with a four-motor drive, exide batteries being used. Loading and unloading is effected by an electric drum in the center of the truck controlled from the seat by a system of levers. The speed of the truck is 7 miles an hour on the level with a complete load. Due to the extreme length of the truck and to the fact that a considerable portion extends over the front wheels it was deemed necessary to equip both front and rear wheels with brakes so that in running down grade the heavier front, which would have a tendency toward causing the truck to accelerate in speed, could be controlled if pressure was applied to both front and rear wheels.

Oregon Companies Permit Switching Calls

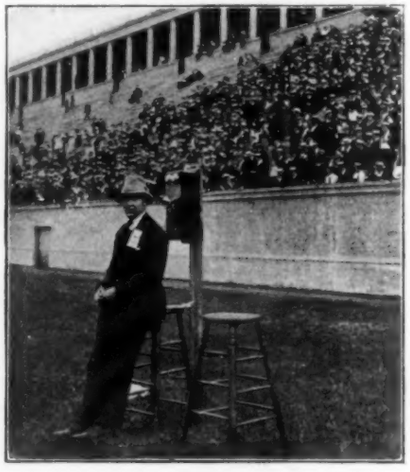
Oregon hotels having both the Home and Pacific telephone systems may now switch calls from one switchboard to the other.

The Pacific Telephone & Telegraph Company has announced, through its attorney, C. H. Carey, to Judge Wolverton, of the United States District Court, the withdrawal of its suit against the Oregon Hotel Company and the State Railroad Commission, by which it sought to restrain the commission's ruling allowing a common-user arrangement.

Telephones for Harvard's Stadium

USING the telephone as an aid in managing athletic contests is an innovation recently put into effect at the New England intercollegiate track meet held in the Harvard stadium at Cambridge, Mass.

A complete magneto telephone system has been installed consisting of a number of No. 1317 type Western Electric telephones. These are placed on wooden poles at various vantage points on the field, at the finish of the mile, the straight-away mark, the start of the 220 and 100 yard dashes, and in the press stand. The telephones are provided with leather carrying straps so that they can be readily carried to the field house at the termination of a meet. Twisted pair copper clad wire fastened to the top of the rim board running around the track makes it possible to connect the telephones at practically all points on the field.



Telephone Installed in Harvard's Stadium.

The first trial of the telephone installation proved most successful in that it enabled the track officials to give orders and obtain information quickly and accurately in regard to the progress of events and so run off the contest with greater dispatch. The telephones in this way save a great deal of needless walking from point to point on the field. By transmitting the results of each race or other contests to the press stand practically at the finish of the event, the work of the newspaper men was greatly facilitated.

Predetermining Current Value at the Receiving End

Read Before the Institution of Electrical Engineers, England

BY PROF. J. A. FLEMING

ALTHOUGH the mathematical treatment of the theory of propagation of alternating currents along linear conductors has been very fully dealt with by various writers, and chiefly by the work of Dr. A. E. Kennelly has been reduced to a form in which it admits of easy arithmetical application in particular cases, there still seems room for some simplification in those practical cases in which an accuracy in results beyond that attainable by the slide rule is not required. The methods here described depend partly on mechanical and partly on graphic processes, but are sufficiently good for much practical work.

Every conductor we use for telephony or for the electrical tranmission of power has four primary and four secondary qualities. The four primary qualities are all scalar quantities, and the secondary are quasi-vector quantities. The primary constants are the inductance (L), the capacity (C), the conductor resistance (R), and the dielectric conductance of the line (S), and are reckoned in henrys, farads, ohms and mhos per mile or per kilometre of loop or double line. The first two are conservative and the last two dissipative qualities. In virtue of the first two energy is stored up in magnetic and electric form around the conductor and in the dielectric. The four secondary qualities of the line are the vector impedance, the vector admittance, the propagation constant, and the line impedance or characteristic. These secondary quantities are denoted by the symbols Im, Ad. P. and Z. They are reckoned at so much per mile or per kilometre, and being quasi-vector quantities have size as well as position angle. The size of these vectors is denoted by putting square brackets round the symbols—viz., $[Im]$, $[Ad]$, $[P]$, and $[Z]$. These vector qualities are defined as follows: Consider a unit length of the conductor subjected to simple harmonic E.M.F., formed of a part of a lead and the corresponding length of the return wire, this unit length being so short that the drop in voltage and current along it is graphically represented by a straight line. Then, if I is the current at the center of the unit, and V is the P.D. at the center between its two wires, and L, C, R, and S are its constants as above, the drop in voltage along it is represented by $RI+jpLI$, and the drop in current by $SV+jpCV$, where $p=2\pi\times$frequency, and j is the sign of perpendicularity. Both these last two quantities are true vectors and denote a voltage or a current. It is convenient, however, to represent them as the product of a quasi-vector and a current or voltage—viz., as $[R+jpL]I$ and $[S+jpC]V$, and to treat these quasi-vectors as vectors in calculations. Hence their respective sizes are $\sqrt{R+p^2L^2}$ *and* $\sqrt{S^2+p^2C^2}$. For unit length of the conductors we have symbols for these quantities as follows:

$$R+jpL=Im,\ S+jpC=Ad,$$
$$\sqrt{R^2+p^2L^2}=[Im],\ \sqrt{S^2+p^2C^2}=[Ad].$$

Now the quantity P or the propogation constant is the geometric mean of the vector impedance Im and the vector admittance Ad, or $P\sqrt{Im}.\sqrt{Ad}$, while the line characteristic or impedance Z is the quotient of the same quantities, or $Z=\sqrt{Im}\sqrt{Ad}$.

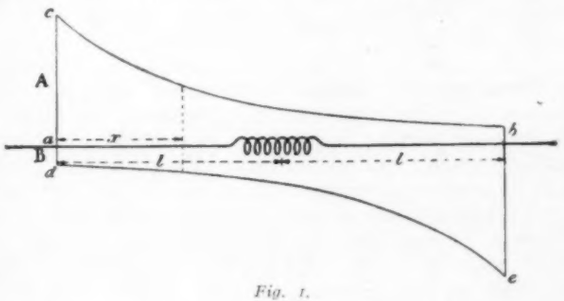


Fig. 1.

Returning then to the unit length of the circuit we can express the drop in voltage and current as follows:—Drop in voltage$=Im\times$Mean current in it. Drop in current$=Ad\times$Mean voltage across it.

Hence the drop in the drop in voltage, or as it may be called the (drop)^2 in the voltage, is given by the equation—Drop in the drop in voltage$=Im\times Ad\times$Mean voltage across it. Let us consider how this can be graphically represented. If we draw an exponential or logarithmetic curve—that is, a curve whose equation is $y=\epsilon^{Px}$, where ϵ is the base of the Napierian logarithms, it is clear that the slope of the curve at any point is proportional to the ordinate, or is equal to Py. Also the slope of the slope or rate of change of slope is proportional to the ordinate and equal to P^2y. Accordingly it is evident that if an alternating E.M.F., V_1 is applied at any point in an infinitely long cable the voltage V at any other point at a distance x will be represented by the exponential expression $V=V_1\epsilon^{-Px}$. In practice, however, all our cables are of finite length, and we have moreover, to take into account the effect of the receiving instrument at the end. Consider then a cable of length l, having a receiving instrument of impedance R^2+jpL^2 placed at the receiving end, and an impressed E.M.F. V_1 applied at the sending end. We may consider that the cable is laid out straight (Fig. 1), and that the applied E.M.F. is represented by a positive potential at one point and an equal negative potential at another point placed at a distance $2l$ in an infinite cable. The receiving instrument is represented by the coil placed in the center. Then each po-

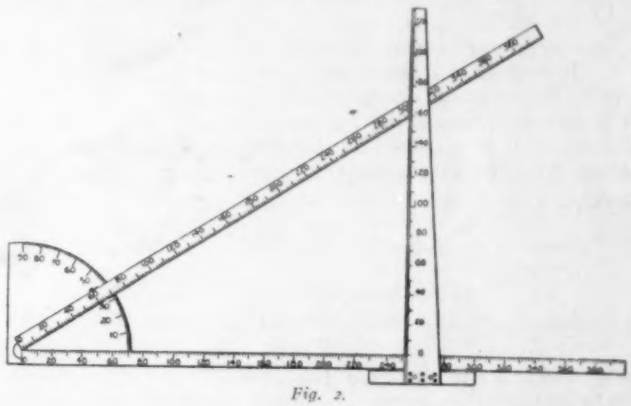


Fig. 2.

tential falls along the cable according to an exponential law, and the potential V at any distance x from the sending end is seen to be the algebraic of two factors, or

$$V=Ae^{-Px}+Be^{+Px} \quad . \quad . \quad . \quad . \quad (1)$$

It is now convenient to substitute for these exponential expressions their equivalent in hyperbolic functions. If we draw two exponential curves, one rising and the other falling and both starting from an ordinate $y=e^{-x}$ at any abscissa x (Fig. 2). If we take half the sum and half the difference of the ordinates at any abscissa, these values are called respectively the hyperbolic cosine and the hyperbolic sine, and are represented by

$$\cosh x=\tfrac{1}{2}\ (e^{x}+e^{-x}), \quad . \quad . \quad . \quad . \quad (2)$$

and

$$\sinh x=\tfrac{1}{2}\ (e^{x}-e^{-x}) \quad . \quad . \quad . \quad . \quad (3)$$

Hence

$$e^{x}=\cosh x+\sinh x, \quad . \quad . \quad . \quad . \quad (4)$$

$$e^{-x}=\cosh x-\sinh x \quad . \quad . \quad . \quad . \quad (5)$$

Substituting these functions for e^{+Px} and e^{-Px} in (1) we have—

$$V=(A+B)\cosh Px-(A-B)\sin Px. \quad . \quad . \quad (6)$$

It is clear that when $x=0$ we have $V=V_1$, and also $\cosh Px=1$ and $\sinh Px=0$; therefore, we have $V_1=A+B$. Again, the current I in any unit of length of the cable is obtained by dividing the drop in potential along it by the vector impedance of the unit. Hence we have

$$I=\frac{P}{R+jpP}(Ae^{-Px}-Be^{+Px}), \quad . \quad . \quad . \quad . \quad (7)$$

$$I=\frac{I}{Z}[(A-B)\cosh Px-(A-B)\sinh Px], \quad . \quad (8)$$

and when $x=0$ we have $I=I_1$: therefore $ZI_1=A-B$. Substituting the values $A+B=V_1$ and $A-B=ZI_1$ in equations (6) and (8), and also bearing in mind that the receiving instrument impedance $Z_r=V_2/I_2$, where V_2 and I_2 are the voltage and current at the receiving end at which $x=l$, it is easy to see that we obtain the equations

$$V_2=V_1\cosh Pl-I_2Z\sinh Pl, \quad . \quad . \quad . \quad . \quad (9)$$

$$I_2=I_1\cosh Pl-\frac{V_1}{Z}\sinh Pl. \quad . \quad . \quad . \quad . \quad (10)$$

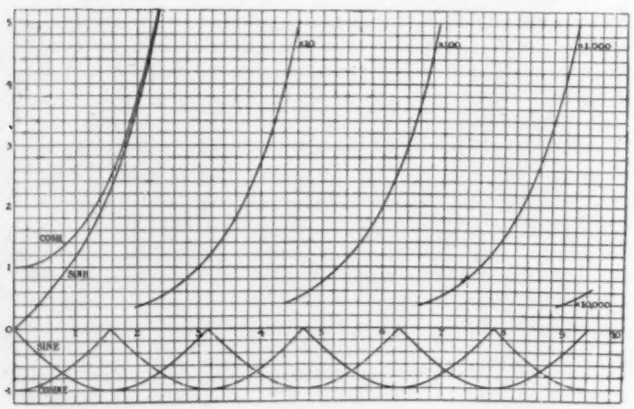


Fig. 3.

Separating the variables and putting $V_2=I_2Z_r$, we obtain the final equations

$$V_1=V_2\left(\cosh Pl+\frac{Z}{Z_r}\sinh Pl\right), \quad . \quad . \quad . \quad . \quad (11)$$

$$I_1=I_2\left(\cosh Pl+\frac{Z_r}{Z}\sinh Pl\right). \quad . \quad . \quad . \quad . \quad (12)$$

These last equations enable us to find the values of V_2 and I_2 from those of V_1 and I_1 when we know the value of the complex factor in the bracket.

In applying the above formulæ (11) and (12) in

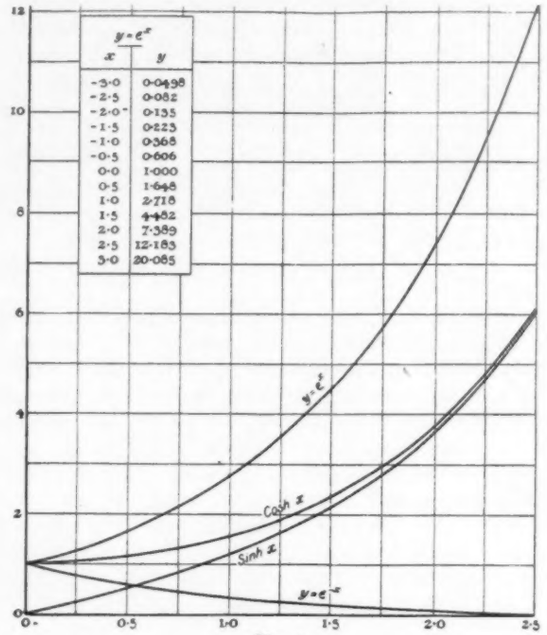


Fig. 4.

numerical calculations in any given case the chief difficulty which arises is that the addition, multiplication and division to be carried out in reckoning the factor in the bracket are vector operations, and the quantities themselves—*viz.*, Z_r, Z, cosh Pl and sinh Pl are complex quantities. If two complex quantities are given in the form $a+jb$, $c=jd$, it is an easy matter to add them, for their sum is $(a+c)+(b+d)$. If, however, we have to divide or multiply them they have to be converted first to the equivalent forms

$$\sqrt{a^2+b^2}\ \angle\tan^{-1}\frac{b}{a} \quad \text{and} \quad \sqrt{c^2+d^2}\ \angle\tan^{-1}\frac{d}{c}$$

These are troublesome arithmetical operations and require also a table of natural tangents. To facilitate this transformation the author has devised a vector calculating rule made as follows: Two boxwood scales about 1.5 metres long have their edges divided into centimetres and millimetres, and are hinged together at the zero ends. A quadrant protractor is attached to one rule so as to show at a glance the angle which the inner edges make with each other when the rule is opened (Fig. 3). A T-square having one edge graduated in centimetres and millimetres slides along one of the rules. Hence if we are given a complex quaitity in the form $300+j400$ we can slide the T-square along so as to set off on one rule an intercept of 300 mm. We then open the rule so that the other arm sets off an intercept of 400 mm. on the T-square edge, and we see at once that the hypothenuse of the triangle is 500 mm. and the slope of the rule is $\tan^{-1}\frac{4}{3}=53$ deg. 7 min. By the aid of the

rule we can then convert the expressions for vectors in the form $a+jb$ and $\sqrt{a^2+b^2}\,/\tan^{-1}\frac{b}{a}$ into one another numerically with great ease. To obtain the square root of a complex quantity given in the form $\sqrt{R+jpL}$ we have to convert $R+jpL$ to the form $\sqrt{R^2+p^2L^2}\,/\tan^{-1}\frac{pL}{R}$, and then to take the square root of the size and half the angle, Hence

$$\sqrt{R+jpL}=(R^2+p^2L^2)^{\frac{1}{4}}\,/\,\tfrac{1}{2}\tan^{-1}\frac{pL}{R}.$$

Accordingly when we are given the primary constants of a cable, viz., R, L, S, and C, and also $p(=2\pi\times$ frequency, $n)$, we can calculate the value of the line impedance, $Z=\sqrt{R+jpL}/\sqrt{S+jpC}$, by finding the vector expressions for $\sqrt{Im}$ and $\sqrt{Ad}$ as above and then dividing the size of the first by that of the second and subtracting the phase angles. The arithmetical operations consist in finding the numerical value of $Z=\sqrt{Im}/\sqrt{Ad}$ or of $\sqrt{R+jpL}/\sqrt{S+jpC}$ and its slope, which is equal to

$$\left(\frac{R^2+p^2L^2}{S^2+p^2C^2}\right)^{\frac{1}{4}}\,/\,\tfrac{1}{2}\tan^{-1}pL/R-\tfrac{1}{2}\tan^{-1}pC/S.$$

This is vastly facilitated by the use of the above rule when only a moderate degree of accuracy is required.

Thus, if we are given the line constants of a standard telephone cable for which $R=88$ ohms, $L=0.001$ henry, $C=0.05$ mfd., $S=5\times10^{-6}$ mho, all per loop mile, and if $p=2\pi n=5{,}000$, we find at once

$$Im=88+j5=88.1/3^\circ\ 15';$$

and

$$Ad=\frac{5}{10^6}+j\frac{250}{10^6}=\frac{1}{4010}/88^\circ\ 51'.$$

Hence

$$Z=\frac{\sqrt{Im}}{\sqrt{Ad}}=593\ |\ 42^\circ\ 48'.$$

In these calculations, if one of the above-described vector calculating rules is not at hand, a single four-figure table of squares and square roots and a table of natural tangents, will be found of great assistance. It is, therefore, quite easy to find the vector value of Z_r/Z or its repicrocal, when we are given the impedance of the receiving instrument and the constants of the line. In the next place we have to find the value of cosh Pl and sinh Pl. Since $P=\sqrt{Im}\,.\,\sqrt{Ad}$, we can obtain the value of P at once in the form of S/θ, and by the aid of the rule convert it to the form $P=a+j\beta$. Thus, for the same standard cable $P=\sqrt{Im}.\ \sqrt{Ad_2}$ or

$$P=\sqrt{\frac{88.1}{4{,}000}}/46^\circ\ 3'\ 30''=0.148/46^\circ\ 3'\ 30''.$$

Converting this back into the form $a+j\beta$ by the aid of the vector rule, we find it is equal to $0.103+j0.104$. Hence $a=0.1$ and $\beta=0.1$ nearly. If then the length of the cable is given, say, 20 miles, we have $Pl=2+j2$. We have in the next place to find the value of cosh Pl and sinh Pl. These quantities are both vectors because $Pl=al+j\beta l$ is a vector. Bearing in mind the exponential values of cosh x and sinh x and cos x and sin x as follows:

$$\cosh x=\epsilon^x/2+\epsilon^{-x}/2,\quad \sinh x=\epsilon^x/2-\epsilon^{-x}/2,$$
$$\cosh x=\epsilon^{xj}/2+\epsilon^{-jx}/2,\quad \sin x=\epsilon^{jx}/2j-\epsilon^{-jx}/2j,$$

it is easy to show that—

$$\cosh(al+j\beta l)=\cosh al\cos\beta l+j\sinh al\sin\beta l,$$
$$\sinh(al+j\beta l)=\sinh al\cos\beta l+j\cosh al\sin\beta l.$$

If then we are given the values of al and βl it is a simple matter to find the values of cosh Pl and sinh Pl from curves delineated in the chart (Fig. 4). In these curves the author has graphically represented the circular and hyperbolic sine and cosine curves plotted in terms of radians as horizontal abscissæ set off along a base line. To distinguish the positive from the negative values of the circular sine and cosine the parts of the curves which have negative values of the ordinates are shown as dotted lines. The values from which the curves are plotted are given in the paper, while the hyperbolic sine and cosine are also plotted to the same arguments from the calculated values. Since, however, these last curves rise up continuously, it is convenient to divide the ordinates by 10 as soon as the first branch of the curve reaches the top of the paper. When the second branch rises to a similar height we divide again by 100, and in a third branch by 1,000. In this way we can plot curves for cosh x and sinh x up as high as cosh 9 and sinh 9 on squared paper of moderate size.

For preliminary rough calculations the use of the above described vector rule in conjunction with a slide rule immensely economizes time.

Would Triple National Debt

A retired telephone official of extended experience, said recently:

"Ten years previous to its consummation I was told by the managers of the National Telephone Company of Great Britain that the government would take over the telephone properties of the United Kingdom. That was a comparatively simple matter in England where the government already owned the telegraph, but if it took ten years to do it in England it will take many times ten years to do it in the United States.

"It is not the 60,000 stockholders in the Bell Telephone Company, controlling 900 millions of property, that have to be reckoned with so much as the 300,000 stockholders in the independent telephone companies. To get an independent telephone company started the promoters had to interest all the local people in the shares and there are more "opposition" stockholders in the United States than there are Bell telephone stockholders.

"If the agitation for taking over the telephone and telegraph companies by the government should be resumed and should not interfere with the growth of the telegraph and telephone systems it would require three thousand millions at the end of ten years, or three times the national debt, for the government to take over the telephone and telegraph systems.

"The people would never stand for this indebtedness, which would put a mortgage of over $100 on every family in the United States.

"But what is the use of talking? Before we can think of taking over the railroads, or the telegraph and telephone companies in this country, we would have to change our laws and disfranchise all government employes. Otherwise, the man who got into office with such an army behind him could never be turned out of office by any popular vote.

"Our neighbors to the South can give us lessons on such a dictatorship."—*Public Service.*

Standards in Telephony and Telegraphy

Tentative Definitions for the Standardization Rules of the A. I. E. E.

AFTER careful consideration it does not seem that the time is yet ripe for a formal standardization of terms and definitions used in telephony and telegraphy. Many of the terms commonly employed are used in more than a single way, and conversely, many pieces of apparatus and many constants which are essentially identical from a physical standpoint have been and are known by more than one designation.

Damping of a Circuit.—The damping, at a given point, in a circuit from which the source of energy has been withdrawn is the progressive diminution in the effective value of electromotive force and current at that point resulting from the withdrawal of electrical energy.

Damping Constant.—The damping constant of a circuit is a measure of the ratio of the dissipative to the reactive component of its admittance or impedance.

Applied to the admittance of a condenser or other simple circuit having capacity reactance, the damping constant for a harmonic electromotive force of given frequency is the ratio of the conductance of the condenser or simple circuit at that frequency to twice the capacity of the condenser at the same frequency.

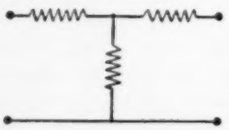
Applied to the reactance of a coil or other simple circuit having inductive reactance, the damping constant for a harmonic current of given frequency is the ratio of the resistance of the coil or circuit at that frequency to twice the inductance at the same frequency.

Equivalent Circuit.—An equivalent circuit is a simple network of series and shunt impedances, which, at a given frequency, is the approximate electrical equivalent of a complex network at the same frequency and under steady state conditions.

Note: As ordinarily considered, the simple networks as defined are the electrical equivalents of complex networks only with respect to definite pairs of terminals, and only as to sending-end impedances and total attenuation. A further requirement is that the only connections between the pairs of terminals are those through the network itself.

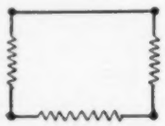
"T" Equivalent Circuit.—A "T" equivalent circuit is a triple star or "Y" connection of three impedances externally equivalent to a complex network.

Symbol:



"U" Equivalent Circuit.—A "U" equivalent circuit is a delta connection of three impedances externally equivalent to a complex network. It is also called a "Π" equivalent circuit.

Symbol:



IMPEDANCE.

Mutual Impedance.—The mutual impedance, for alternating currents, between a pair of terminals and a second pair of terminals of a network, under any given condition, is the negative vector ratio of the electromotive force produced between either pair of terminals on open circuit to the current flowing between the other pair of terminals.

Self-Impedance.—The self-impedance between a pair of terminals of a network, under any given condition, is the vector ratio of the electromotive force applied across the terminals to the current produced between them.

LINE CHARACTERISTICS.

Characteristic Impedance.—Characteristic impedance of a line is the ratio of the applied electromotive force to the resulting steady-state current upon line of infinite length and uniform structure, or of periodic recurrent structure.

Note: In telephone practice, the terms (1) line impedance, (2) surge impedance, (3) iterative impedance, (4) sending-end impedance, (5) initial sending-end impedance, (6) final sending-end impedance, (7) natural impedance, and (8) free impedance, have apparently been more or less indefinitely and indiscriminately used as synonyms with what is here defined as "characteristic impedance."

Sending-End Impedance.—The sending-end impedance of a line is the vector ratio of the applied electromotive force to the resulting steady-state current at the point where the electromotive force is applied.

Note: See note under "Characteristic Impedance." In case the line is of infinite length of uniform structure or of periodic recurrent structure, the sending-end impedance and the characteristic impedance are the same.

Propagation Constant.—The propagation constant per unit length of a uniform line, or per section of a line of periodic recurrent structure is the natural logarithm of the vector ratio of the steady-state currents at various points separated by unit length in a uniform line of infinite length, or at successive corresponding points in a line of recurrent structure of infinite length. The ratio is determined by dividing the value of the current at the point nearer the transmitting end by the value of the current a the point more remote.

Attenuation Constant.—The attenuation constant is the real part of the propagation constant.

Wave-Length Constant.—The wave-length constant is the imaginary part of the propagation constant.

LINE CIRCUITS.

Ground-Return Circuit.—A ground-return circuit is a circuit consisting of one or more metallic conductors in parallel. with the circuit completed through the earth.

Metallic Circuit.—A metallic circuit is a circuit of which the earth forms no part.

Two-Wire Circuit.—A two-wire circuit is a metallic circuit formed by two paralleling conductors insulated from each other.

Superposed Circuit.—A superposed circuit is an additional circuit obtained from a circuit normally required for another service, and in such a manner that the two services can be given simultaneously without mutual interference.

Phantom Circuit.—A phantom circuit is a superposed circuit, each side of which consists of the two conductors of a two-wire circuit in parallel.

Side Circuit.—A side circuit is a two-wire circuit forming one side of a phantom circuit.

Non-Phantomed Circuit.—A non-phantomed circuit is a two-wire circuit, which is not arranged for use as the side of a phantom circuit.

Simplexed Circuit.—A simplexed circuit is a two-wire telephone circuit, arranged for the super-position of a single ground-return signaling circuit operating over the wires in parallel.

Note: In view of the use of the term "Simplex Operation" in telegraph practice, it is felt that the designation "Simplexed Circuit" as applied to the arrangement described is not a happy one.

Composited Circuit.—A composited circuit is a two-wire telephone circuit, arranged for the super-position on each of its component metallic conductors, of a single independent ground-return signaling circuit.

Quadded or Phantomed Cable.—A quadded (or phantomed) cable is a cable adapted for the use of phantom circuits.

Note: The type of cable here defined has frequently been designated as "Duplex Cable," a term which is objectionable, both on account of its lack of description and its widely different use in telegraph practice.

LOADING.

Loaded Line.—A loaded line is one in which the normal inductance of the circuit has been altered for the purpose of increasing its transmission efficiency for one or more frequencies.

Series Loaded Line.—A series loaded line is one in which the normal inductance has been altered by inductance serially applied.

SHUNT LOADED LINE.—A shunt loaded line is one in which the normal inductance of the circuit has been altered by inductance applied in shunt across the circuit.

CONTINUOUS LOADING.—A continuous loading is a series loading in which the added inductance is uniformly distributed along the conductors.

COIL LOADING.—A coil loading is one in which the normal inductance is altered by the insertion of lumped inductance in the circuit at intervals. This lumped inductance may be applied either in series or in shunt.

Note: As commonly understood, coil loading is a series loading, in which the lumped inductance is applied at uniformly spaced recurring intervals.

MICROPHONE.—A contact device designed to have its electrical resistance directly and materially altered by slight differences in mechanical pressure.

RELAY.—A relay is a device by means of which contacts in one circuit are operated under the control of electrical energy in the same or other circuits.

RESONANCE.—Resonance of a harmonic alternating current of given frequency, in a simple series circuit, containing resistance, inductance and capacity, is the condition in which the positive reactance of the inductance is numerically equal to the negative reactance of the capacity. Under these conditions, the current flow in the circuit with a given electromotive force is a maximum.

RETARDATION COIL.—A retardation coil is a reactor (reactance coil) used in a circuit for the purpose of selectively reacting on currents which vary at different rates.

Note: In telephone and telegraph usage the terms "impedance coil," "inductance coil," "choke coil" and "reactance coil" are sometimes used in place of the term "retardation coil."

SKIN EFFECT.—Skin effect is the phenomenon of the non-uniform distribution of current throughout the cross-section of a linear conductor, occasioned by variations in the intensity of the magnetic field due to the current in the conductor.

TELEPHONE RECEIVER.—A telephone receiver is an electrically operated device designed to produce sound waves or vibrations which correspond in form to the electromagnetic waves or vibrations actuating it.

TELEPHONE TRANSMITTER.—A telephone transmitter is a sound-wave or vibration-operated device designed to produce electromagnetic waves or vibrations which correspond in form to the sound-waves or vibrations actuating it.

TRANSFORMERS.

THE COEFFICIENT OF COUPLING OF A TRANSFORMER.—The coefficient of coupling of a transformer at a given frequency is the vector ratio of the mutual impedance between the primary and secondary of the transformer, to the square root of the product of the self-impedance of the primary and secondary.

REPEATING COIL.—A term used in telephone practice meaning the same as transformer, and ordinarily a transformer of unity ratio.

RADIO.

ACOUSTIC RESONANCE DEVICE.—One which utilizes in its operation mechanical or other resonance to the audio frequency of the received impulses.

ANTENNA.—A system of conductors designed for radiating or absorbing the energy of electromagnetic waves.

ATMOSPHERIC ABSORPTION.—That portion of the total loss of radiated energy due to atmospheric conductivity.

AUDIO FREQUENCIES.—The normally audible frequencies lying between 20 and about 20,000 cycles per second. (See also Radio Frequencies.)

CAPACITY COUPLER.—An apparatus which electrostatically joins portions of two circuits, and thereby permits the transfer of electrical energy between these circuits through the action of electric forces.

COEFFICIENT OF COUPLING.—See under "Transfers."

CONDUCTIVE COUPLER.—An apparatus which magnetically and electrically joins two circuits having a common conductive portion (also known as a Direct Coupler).

COUNTERPOISE.—A system of electrical conductors forming one plate of a condenser, the other plate of which is the ground. For alternating current, it may be used to replace a direct connection to ground.

DAMPING OF A CIRCUIT.—See second paragraph.

DAMPING FACTOR OF A SIMPLE CIRCUIT.—The ratio of the effective resistance of that circuit to twice the effective inductance at any frequency. (The reciprocal of a time.) This term applies only to circuits capable of carrying free alternating currents. (See third paragraph.)

DETECTOR.—That portion of the receiving apparatus which, connected to a circuit carrying currents of radio-frequency, and in conjunction with a self-contained or separate indicator, translates the radio-frequency energy into a form suitable for operation of the indicator. This translation may be effected either by the conversion of the radio frequency energy, or by means of the control of local energy by the energy received.

ELECTROMAGNETIC WAVE.—A progressive disturbance characterized by the existence on the wave front of electric and magnetic forces acting in directions which are perpendicular to each other and to the direction of propagation of the wave.

FORCE ALTERNATING CURRENT.—One produced in any circuit by the application of an alternating electromotive force.*

FREE ALTERNATING CURRENT.—That produced by an isolated electrical displacement in a circuit having capacity, inductance, and *less* than the critical resistance.†

CRITICAL RESISTANCE OF AN OSCILLATING CURRENT CIRCUIT.—Twice the square root of the ratio of the inductance of that circuit to the capacity of that circuit, both expressed in practical units. This term applies only to circuits capable of carrying free alternating currents.

GROUP FREQUENCY.—The number of distinguishable alternating current groups occurring per second in an electrical circuit.

Note 1: The group referred to above is, in general, mainly a free alternating current, which is substantially damped to extinction before the beginning of the following group or train.

Note 2: The acoustic pitch of the note in the receiving station is, in general, determined by the group frequency at the transmitting station.

Note 3: The term "Group Frequency" replaces the term "Spark Frequency."

INDUCTIVE COUPLER.—An apparatus which magnetically joins portions of two electric circuits.

LINEAR DECREEMENT OF A CIRCUIT CONTAINING A RESISTANCE ELEMENT EQUIVALENT TO A SPARK.—The difference of successive current amplitudes in the same direction divided by the larger of these amplitudes. (In circuits containing such an element, not the ratio of successive current amplitudes, but their difference is constant, and characteristic of the damping.)

LOGARITHMIC DECREMENT.—Logarithmic decrement of a circuit containing inductance, capacity and constant resistance is one-half the ratio of the electrical energy withdrawn from that circuit during a cycle to the total energy present in that circuit at the beginning of the cycle. It also equals the natural logarithm of the ratio of successive current amplitudes in the *same* direction.

Note: Logarithmic decrements are standard for a complete period or cycle.

RADIO FREQUENCIES.—Those above 20,000 cycles per second. (See also Audio Frequencies.)

Note: It is not implied that radiation cannot be secured at lower frequencies and the distinction from audio frequencies is merely one of definition.

RESONANCE TO A ALTERNATING CURRENT.—See Resonance under "Loading."

A RESONANCE CURVE gives the relation between circuit power, current or voltage at various frequencies of excitation as a function of those frequencies.

A WAVE-LENGTH RESONANCE CURVE is one wherein the abscissas are ratios of specified wave-lengths to the resonant wave-length, and the ordinates are ratios of the energy (or square of the current) at corresponding specified wave-lengths to the energy (or square of the current) at the resonant wave-length. The scale of ordinates and abscissas shall be equal.

A FREQUENCY RESONANCE CURVE.—One wherein the abscissas are ratios of specified frequencies to the resonant frequency, and the ordinates are ratios of the energy (or square of the current) at corresponding specified frequencies to the energy (or square of the current) at the resonant frequency. The scales of ordinates and abscissas shall be equal.

A STANDARD RESONANCE CURVE, unless otherwise specified, is assumed to be a wave-length resonance curve.

SELECTING.—The process of adjusting an element driven by a plurality of simultaneous impulses, until the ratio of desired response to undesired response is a maximum.

SUSTAINED RADIATION consists of electromagnetic waves of constant amplitude (such as are emitted from an antenna in which flows a forced alternating current).

*In power applications termed simply an alternating current.
†In power applications termed simply an oscillating current.

Tuning.—The process of securing the maximum indications by adjusting the time period of a driven element. (In transmitter or receiver.)

Wave-Length Meter.—A radio frequency measuring instrument calibrated to read wave-lengths.

Rating. 1. All radio transmitting sets shall be rated in actual power output measured in the antenna.

Note: The group or audio frequency of the note of the station should be stated as well (except for sustained wave sets, where that characteristic should be mentioned).

2. The over-all efficiency of a radio transmitting station shall be the ratio of the actual power output as measured in the antenna to the power input supplied to the first piece of electrical machinery which is definitely a part of the radio equipment.

Sections under "Radio" have been inserted after conference with the Standards Committee of the Institute of Radio Engineers.

Milliammeter on the Test Desk

The adoption of the voltmeter on the central-office test desk practically coincided with the adoption of common-battery signaling on the switchboard. The first desk so equipped in Chicago, for example, was installed in Oakland office in 1892 to care for the "express" portion of that exchange. It is universally recognized as indispensable to the maintenance of the high insulation necessary with that system of signaling. On the other hand until the recent authorization of its general use by the A. T. & T. Company, the use of the milliammeter was largely local to Chicago territory, says G. W. Cummings in the *Bell Telephone News*, and the question as to why our practice differs from that of other companies is a natural one.

While we began the use of the milliammeter in 1902, its present popularity with us dates from our adoption of the current method instead of the resistance method of relay adjustment and our realization of the transmission difficulties involved in furnishing service from one exchange system over 190 square miles of territory. The two principal things which we wish to know, as affecting the service over a line, are first, the current on the line which is available to operate our relays or may prevent them from releasing; and second, the amount of current which the subscriber has to talk with. This information the milliammeter not only gives directly—picking up as well any momentary fluctuations due to intermittent trouble—but since it is normally looped into the testing circuit our test is made automatically, without the necessity of throwing a key or interrupting a conversation with a subscriber by banging him in the ear.

Without the milliammeter this information can be gained only by throwing in the voltmeter—cutting our listening circuit off and depriving us of the use of that most sensitive of instruments, the ear—calculating the resistance from the reading or taking it from a table, and then calculating the current. The calculation is not difficult, but wastes valuable time and increases the liability to error, especially if the testing battery is not absolutely true to voltage or if the trouble is intermittent.

Up to recently the standard in branch exchange practice in Chicago, was the use of the C-16 BX trunk circuit, which signals with the branch battery. Under ordinary conditions this arrangement is entirely satisfactory, and admits of a circuit which is ideally simple. As an illustration of what would be necessary in testing this circuit without a milliammeter, on a report of permanent disconnect it would be necessary to call the branch operator, have her put up a cord and close her key, measure the earth potential on the tip—if it remains constant long enough—measure the resistance to ground on the tip, using the shunt key and allowing for the earth potential, measure the branch battery on the ring, allowing for the earth potential, measure the office battery, subtract to find the net E. M. F., and calculate the current available for supervision from this E. M. F. and the line and apparatus resistance. The procedure on a report of "can't raise office" is hardly less involved. These are very common cases, and we have not the time to waste in this way when a milliammeter gives the desired information in an instant. In addition to the time required, a trial of the above method showed an error of thirty per cent, as compared with a milliammeter reading, due to variation in earth potential, fractional errors in reading, and perhaps errors in the apparatus resistances assumed.

Reports of "no disconnect" are aggravated in our territory by the fact that about one-half—48.99 per cent in the Chicago exchanges and 37.12 per cent in the suburban exchanges on March 1, 1914—of our stations are four-party. Two systems of ringing these stations are used, both of which involve an appreciable leakage of current through the ringers, especially in the suburban territory. This leakage is often increased by earth potential and other special causes until it is dangerously close to the releasing point of the supervisory relays. In doubtful cases the milliammeter tells us directly whether the leakage is above or below the relay adjustment, and avoids the necessity for calculation or guess work.

In a small exchange the amount of testing done would perhaps not warrant the expense of a milliammeter. In Chicago we gave the No. 2 desk a thorough trial in Lawndale exchange under conditions which enabled us to make an accurate comparison between its performance and that of our milliammeter desk. The special BX and four-party conditions mentioned above were eliminated so far as the regular desk was concerned, putting the testing on the same basis as in other cities. We had anticipated that No. 2 desk would prove somewhat slower than the other type, but estimated that two positions would be enough to handle the work. In practice we found that three and sometimes four positions were needed, indicating that the No. 2 desk was at least fifty per cent slower than the other, as well as being less accurate. In a busy exchange this difference in testing time would pay for a milliammeter very suickly, the simplicity of the milliammeter method puts less of a tax on the ability of the testman, and its greater accuracy is productive of higher standards of construction and maintenance.

Cast Iron Poles Snap

A furniture van at Brighton, England, recently collided with a cast-iron pole carrying telephone wires. The pole snapped at the bottom and fell. The strain of the wires and the weight of the pole brought down 17 other poles in quick succession. The local telephone service was disorganized and the trunk lines to London were interrupted.

Several Central African mines have given up their telegraphic lines from the mines to the railroad stations for a very peculiar reason. The African savages, especially the women, have found the copper wire to be very good for making ornaments and the wires disappeared with such speed that it was impossible for the company to keep the proper relation between supply and demand, and finally decided to substitute wireless telegraphy.

Line Interference Considered Legally

Read Before the Iowa Independent Telephone Association

BY HAROLD L. BEYER

Harold L. Beyer.

BECAUSE of the rapid development and use of electricity to meet the manifold needs of our present complex life, and of the further fact that currents of different degrees of intensity are required for the various purposes served, it was inevitable that numerous construction and operation problems should arise, due to interferences of one current with another, and that out of them disputes, and even litigation, should grow. Fortunately, the spirit of co-operation and fair play has generally prevailed amongst the various utility companies, with the result that mutual rights have been respected and safeguarded in the vast majority of cases.

Telephone and telegraph wires, owing to the low current required for the transmission of messages, have always been sensitively subject to the evil results of induction and conduction and from contact with nearby wires carrying currents of high voltage. Obviously the public needs electricity for light, power and transportation as much as it requires the conveniences of the telephone and telegraph. It can not get along without any of them. Moreover, the electric light and power company, the electric railway company, the telegraph company and the telephone company are interdependent Each, at times, must make use of the facilities afforded by the others.

It therefore follows that anything which affects the well being and successful operation of one public utility immediately affects the others. The rights of all can be and are being, protected by engineering foresight, as well as by legislation, the railroad and utility commission and the courts

A brief consideration of the Iowa statutory provisions with reference to electric wires is first in order. Section 2158 of the code authorizes the construction of telephone and telegraph lines with the necessary fixtures therefor, along the public roads of the state or across rivers or over any land belonging to the state or any private individual. Construing this section, our Supreme Court has held that the term "public highways" as used, includes city streets. (*Chamberlain vs. Iowa Telephone Co.*, 119 *Iowa* 619.) Section 2159 provides as follows:

> Such fixtures shall not be so constructed as to incommode the public in the use of any road or the navigation of any stream; nor shall they be set up on the private grounds of any individual without paying him a just equivalent for the damage he thereby sustains.

General supervision over "all wires for transmitting electric current or any other wire whatsoever crossing under or over any track of a railroad in this state" is placed in the Board of Railroad Commissioners. The board is also vested with authority to secure information as to all such wires crossings and to order such changes as it may deem necessary in order to make the same comply with its rules and regulations which have been prescribed by the commissioners. (Code Supp. Sec. 2120-d-2120-j.) Cities and towns are authorized by Code, Section 775, to regulate the poles and wires of telephone, telegraph, street railway, electric light and other electric companies.

A possible source of confusion and conflict results from the fact that we have laws on our Iowa statute books vesting the control of electric transmission lines in the Board of Supervisors of every county in the state and also in the Board of Railroad Commissioners. Chapter 94 of the Laws of the 33d General Assembly authorizes boards of supervisors to grant the use of the public highways for the erection and maintenance of poles and wires for the transmission of electricity and fixes the liability for damages arising from the construction thereof. Applcation in writing is made to the board designating the particular highways on which it is desired to erect the lines to conduct electricity for lighting, heating and power purposes. Grants for not to exceed twenty years may be made after notice of the hearing of the application shall have been "published once a week for two consecutive weeks in a newspaper printed and published in the county seat, and of general circulation in such county, stating the time when such application will be acted upon and designating the particular highways named in such application." All such grants are made on the express condition that the grantee shall not have an exclusive right to use the highway for conducting electricity; that the poles and fixtures shall be constructed so as not to "incommode the public in the use of any road or the navigation of any stream"; that if a road along which such lines have been constructed is changed, the owner of such line shall on ninety days' notice in writing remove such line to the road as established; that "only strong and proper wires, properly insulated, attached to strong and efficient supports and insulated at all points of attachment" shall be used; that all wires, as soon as they become unsafe through ordinary wear, shall be replaced with new wires, and that all wires the use of which is abandoned shall be taken down; that "every wire carrying electric light, heat or power currents where it enters a building and within such building, so as to avoid danger from fires" shall be properly insulated; that "where such wires are carried across or under wires used for other service, there shall be suspended under or over said power, heating or light service lines, properly constructed and insulated guard nets, or shall be protected by such other equally efficient devices as will prevent contact with such other service lines in case of sagging or breaking of such wires"; and that the owners of such lines "shall be responsible for all damages that may arise from such construction and operation under this grant or from a failure to comply with said provisions."

At the last session of our legislature a law was passed (Chapter 174 of the Laws of the 35th General Assembly) which confers power upon the Railroad Commission to grant franchises to individuals and corporations organized under the laws of Iowa, or authorized to transact business in Iowa, to engage in the manufacture, sale or distribution for sale of electric current, to construct transmission lines and obtain the necessary interests in real estate therefor, and prescribes the manner of making compensation to the owners of the land for such rights. No reference in this law is made to Chapter 94 of the Laws of the 33d General Assembly conferring authority on the boards of supervisors in these matters. Whether the earlier law is to be deemed as repealed by implication, will not be known until our Supreme Court has passed upon the question. It may be worth while to analyze the new law somewhat carefully.

Section 1 deals with the subject of franchises. Franchises may be granted enabling the grantee "within the state, except in cities and towns, to erect, use and maintain poles, wires, guy-wires, towers, fixtures and other necessary construction for the purpose of conducting electricity for lighting, power and heating purposes over, along and across any public land, highways or streams or the lands of any person or persons, and to acquire the necessary interest in real estate therefor."

The applicant for such a franchise must file with the commissioners a petition in writing, setting forth "the manner, methods and specifications for the construction of such line, together with a general description of the public lands, highways, streams or private lands over which it is desired that said transmission line be constructed, together with a map showing the starting point, route and terminus of said proposed line." Time for a hearing upon such petition is then fixed by the commission and at least ten days' notice thereof given by publication, "in the official newspapers of each county into or through which said proposed line extends," such notice being addressed to the citizens of the county and containing "a statement as to the purpose of the petition, a description of the lands to be traversed by the transmission line and the date and place" of the hearing. Objections in writing to the proposed line, either as to its establishment or location, may be filed with the commission and must be given due consideration. The commission is authorized to examine the proposed route and may grant the application as made or may modify as it may see fit and grant the franchise as so modified.

The privilege granted by the commission shall be and constitute a franchise to operate and maintain the proposed transmission line, but all rights granted by said franchise shall be subject to the provisions of this act and also such regulations as the legislature may, from time to time, prescribe, either by direct legislative enactment or by and through the railroad commission, under the laws of Iowa, now or hereafter in force.

Section 2 authorizes the commission to grant authority to persons or corporations operating transmission lines to acquire additional rights under this act. The procedure is the same as upon the original petition, but before acting upon it the applicant, must "file its consent that the provisions of this act and of all acts or laws relating to public utilities which are now in force or which may be hereafter enacted shall apply to its existing line or lines with the same force and effect as though said line or lines had been constructed under a permit provided for in Section 1."

Section 3 provides that any transmission line which secures a franchise under this act shall be held conclusively to have accepted the provisions of this act and of all laws relating to public utilities, their regulation, supervision and control, now or hereafter in force and "to such reasonable regulation as the commission may, from time to time, prescribe."

Section 4 vests in the grantee of a franchise under this act "the right of eminent domain to such extent as may be necessary and as prescribed and approved by the commission, 'not exceeding twenty-five feet in width.'" The proceedings for taking private property for transmission lines are the same as where such property is taken for works of internal improvement. (See Code, Title IX, Chapter 4, and amendments thereto.)

Section 5 vests in the railroad commission power of supervision over the construction, operation and maintenance of transmission lines, and provides as follows:

The railroad commission shall have power of supervision over the construction of said transmission line and over its future operation and maintenance, and said transmission line shall be constructed near and parallel to the right of way of the railways of the state or along the division lines of the lands, according to the government survey thereof, wherever the same is practicable and reasonable, and so as not to interfere with the use by the public of the highways or streams of the state, nor unnecessarily interfere with the use of any lands by the occupant thereof, and shall be built of strong and proper wires attached to strong and sufficient supports properly insulated at all proper points of attachments; all wires, poles and other devices which by ordinary wear or other causes are no longer safe shall be removed and replaced by new wires, poles or other devices, as the case may be, and all abandoned wires, poles or other devices shall be at once removed.

Note how similar the foreging provision is to the laws of the 33d General Assembly relating to control by boards of supervisors. This might indicate that the legislature meant the new law to supersede the old and to place these important matters in the hands of one governing body.

Where wires carrying currents are carried across, either above or below wires used for other service, the said transmission line shall be constructed in such manner as to eliminate, so far as practicable, damages to persons or property by reason of said crossing; there shall also be installed sufficient devices to automatically shut off electric current through said transmission line whenever connection is made whereby current is transmitted from the wires of said transmission line to the ground, and there shall also be provided a safe and modern improved device for the protection of said line against lightning.

No transmission line shall be constructed, except by agreement, within one hundred feet of any dwelling house or other building, except where said line crosses or passes along a public highway or is located alongside or parallel with the right of way of any railway company.

At any crossing of any highway by said transmission lines, the poles or towers next to the highway shall be labeled with the following words:

"Danger .....
..... volts
Electricity."

The stroke of said letters and numbers shall be at least four inches in length and not less than five-eighths of an inch in width, and the color of the letters and numbers shall be in contrast with the color of the background. The said labels shall show the maximum number of volts of electricity transmitted over said line, and said label shall face toward the highway.

Where said poles or towers are extended along said highway and within the limits thereof or immediately adjacent thereto, the sign hereinbefore described shall be placed at least every quarter of a mile.

The commission shall have full power and authority to add such further and additional rules and regulations as regards location, construction, operation and maintenance of said transmission line as may be reasonable.

Section 6 provides that when injury to person or

property is caused by any transmission line operating under this act "negligence will be presumed on the part of the person or corporation operating said line in causing said injury, but this presumption may be rebutted by proof, but no change in the rule of the burden of proof shall exist in favor of employes of the person or corporation operating said transmission line who are charged with or engaged in the construction, reconstruction, repair or maintenance thereof."

Section 7 regulates the adjustment of damages caused in the course of construction and maintenance and provides that damages to land or crops caused by entering, using and occupying such lands for the construction of transmission lines, and repairing same, shall be paid annually at the end of each season, in the county where caused, to the owners of the land except in cases where agreements are entered into with said owners by the transmission line companies.

So much for the rights and powers of transmission companies under our laws. It is a fact that a number of such lines are under construction, and some of them are ready to operate at the present time in different parts of Iowa. Some litigation is now pending as a result of actual or threatened interference. In the District Court of Mills County in the case of *Mills County Telephone Co., and Iowa Telephone Co. vs. Central Station Engineering Co., et al.*, the complainant was granted a temporary injunction restraining the defendant from sending current over its high tension lines until certain changes in construction had been made. Access has been had only to the decree, which was entered in this case in open court upon consent of the parties and nothing is known of the surrounding circumstances. Since this was a consent decree, its authority as a precedent in this state is not of the greatest value. It may be of interest to note some of the findings and orders in this case. The court found that the plaintiffs were the prior and lawful occupants of the highways in the city of Glenwood, in the towns of Mineola and Silver City and in the country highways of Mills county, and that they were entitled to use and enjoy their telephone lines in such highways free from substantial interference by and danger from the high tension electric light and power lines erected by defendants, who had lately constructed their lines in the highways and which the court found did interfere with and endanger the telephone lines of the plaintiffs and the patrons thereof. The defendants were ordered to make numerous changes within thirty days. It appeared that the defendants had built their high tension lines above and parallel to the telephone lines of the plaintiff in several places. The court ordered the transmission line company to remove telephone poles of the plaintiffs to the opposite side of the road at all such points, and to install same in a workman-like manner under the supervision of an agent of the plaintiffs, communication on the telephone lines not to be interrupted by said removal, the cost of supervision alone to be borne by the plaintiffs. At all points where the plaintiffs' and defendants' lines crossed, the court ordered that there be a vertical clearance of the power lines over the telephone lines of not less than eight feet; that at all crossings the high tension lines be placed above the telephone lines; also that numerous other construction specifications be complied with which we need not here consider in detail. A decree in this suit was entered May 1, 1912.

An application for temporary injunction made in the Mahaska County District Court by the *Oskaloosa Home Telephone Co. vs. Oskaloosa Traction & Light Co.* was denied recently, the defendant having filed an answer denying the allegations of the petition and being a solvent corporation. If the defendant company had been insolvent or not able to respond in damages it is believed that an injunction would have been granted. A suit for damages between the same companies is now pending as are also two injunction suits against the same company brought by the New Sharon Public Utility Company, and the Interior Telephone Company, of Grinnell. Those present here probably know of other similar suits now in course of litigation.

As yet, no cases involving the interference of transmission lines with telephone companies have been adjudicated by the Iowa Supreme Court.

Recognizing the necessity for standardizing construction practice for overhead crossings for electric light and power lines, a joint committee of the National Electric Light Association, the American Institute of Electrical Engineers, the American Electric Railway Association, the Association of Railway Telegraph Superintendents and the American Railway Engineering and Maintenance of Way Association, has formulated a set of specifications which will undoubtedly meet with general approval and adoption. With slight modifications they were adopted by an order of the California Public Utilities Commission entered December 1, 1912, for all lines transmitting a current of 15,000 volts and higher voltage.

In December, 1912, the California Commission authorized a committee of fifteen engineers representing the wire interests of California to investigate the subject of inductive interference between power and communication lines and to make recommendations for commission rulings intended to prevent undue interference. The committee has been steadily at work and reported in September, 1913, progress made up to that time. A field force of from five to eight experimenters and computors was employed and equipped with laboratories and a large amount of apparatus, including an oscillograph having three vibrators, noise standards, and impedence bridge, complete equipment for harmonic analyses, and instruments of various kinds, some of it especially designed for the work, representing an outlay of about $9,000, the funds having been voluntarily contributed by the power and communication interests of the state. It has been found difficult to draft general remedial measures, but it hopes ultimately to formulate such specifications as will standardize construction and operations, and reduce to a minimum interruptions of service. The members of the committee feel that this will enable the Railroad Commission to make rulings that for the future will reduce harmful agitation, legislation and litigation. Such work as this shows a practical way of dealing with this vastly important subject, and we in Iowa ought either to have the work of the California committee adopted here by the utility interests or have a similar investigation made on our own account, perhaps in connection with the engineering department of the Iowa State College at Ames. At the same time we should set to work to have our laws amended, taking away from boards of supervisors and vesting in our Railroad Commission control of all transmission lines operating in Iowa.

In the absence of authority in our own state, it may be not without interest and profit to examine as briefly as possible the law relating to this subject as it is found in text books and in reported cases in other jurisdictions. The law is thus summarized in *2 Joice on Electric Law*, 2 Ed., Sec. 517:

Upon the question of interference by the electric wires of one company with the wires of another electrical company the following general rule may be stated, being clearly sustained by the weight of authority. As between different electrical companies, prior authority to one of the companies to occupy, or prior occupation of the streets, will not confer upon such company an exclusive right. The right of the prior licensee, however, must not be substantially injured by the later company. Such subsequent licensee is under the duty to so maintain its wires and lines as not to interfere with the right of a prior occupant of the streets to properly maintain and operate its lines and to transact the business it is authorized by its franchise to transact.

The following statement is found in 6 *Pommeroy's Equity Jurisprudence,* Sec. 635:

In the cases which have arisen, neither party has been entitled to an exclusive right. Both have had authority to use the street. As a matter of law, it is held that "Where a person is making lawful use of his own property or of a public franchise, in such a manner as to cause injury to another, the question of his liability will depend upon the fact whether he has made use of the means which, in the progress of science and improvements, have been shown by experience to be the best" hence it is held that a street railway company will not be enjoined from maintaining a trolley wire in the center of the street merely because the grounding of the wire causes a current in telephone wires by conduction. Where, however, wires are strung so close to others as to cause induction which might be prevented by placing the wires at a greater distance, a right is infringed and an injunction is a proper remedy. The ground of the jurisdiction has been said to be that defendant's conduct "is an unwarranted usurpation amounting to a trespass on plaintiff's rights which is recurrent, continuous and tending to a multiplicity of suits."

In *Paris Electric Light and Railway Company vs. Southwestern Tel. & Tel. Co.* (Tex. Civ. Ap.) 27 *S. W.* 902, 5 *Am. Elect. Cas.* 262, April 19, 1894, the telephone company was seeking to enjoin the light company from maintaining its wires nearer than four feet to those of the telephone company The injunction was granted. The telephone company held a prior franchise and had operated its lines several years before the light company secured its franchise. The court found, among other conclusions of fact, "that said wires were strung nearer than four feet, which created danger of wires and of injury to persons and danger to human life. * * * There is space sufficient along said streets for appellant (the light company) to string wires not nearer than four feet to those of appellee, and carry on its business and render efficient service to its customers."

The court took the position that as the telephone company's franchise was superior in point of time to that of the light company, and had been acted upon, the subsequent licensee could not interfere with the use and enjoyment of the older right by placing its wires in such close proximity to those of the telephone company as to impair the efficiency of the latter's telephone service.

Under a similar state of facts, in *Bell Telephone Co. vs. Belleville Electric Light Co.,* 12 *Ont.,* 571, 2 *Am. Elect. Cas.* 330. 1886, the electric light company had placed its wires on the same side of the street and only two feet above the telephone wires, where it was claimed there was great danger of the electric light wires breaking and falling upon the telephone wires, diverting the strong current of the light company to the telephone wires, producing fire at the end of the telephone wires, destroying the telephone instruments and injuring the buildings in which they were contained, and an injunction was allowed. The court recognized the well established principle that prior use by the telephone company did not give it exclusive possession or right to the use of the side of the road on which it had placed its poles, but being on the ground it had the right to be protected against any interference or act to its injury. It was further held that there was danger in the position of the wires, that the defendants were wrongdoers and they were ordered to transfer their wires to the other side of the street.

It appears that if the company complained of is violating a municipal ordinance or the terms of its franchise and in general acts in an arbitrary and unreasonable manner, an injunction will lie at the suit of a telephone company against a transmission company to compel the offending company to comply with the ordinance provisions. (See *Birmingham Traction Co. vs. Southern Bell Telephone Co.,* Alabama Supreme Court, October 28, 1898, 7 *Am. Elect. Cas.* 405.) In this case the telephone company had operated its system in Birmingham ten years prior to the suit, at which time the traction company was making the necessary mechanical changes to substitute electricity for steam power on its street railways. The construction of the trolley wires was faulty in that the wires in some instances touched the telephone company's wires and the defects were called to the defendant's attention. The defendant's manager not only refused to correct the defects, but stated that if the telephone company did not make the necessary changes itself, the defendant would tear up the complainant's wires and poles. The local ordinance required companies running electric light power or trolley wires under telephone, fire alarm and telephone wires to secure permission so to do, and to pay the expense of raising the wires if unlawfully constructed; it also required guard wires to be installed by the person or company making the last construction. The court held that equity would interfere to control corporations such as these and to keep them within the line of their authority and subject to law.

The earliest case on this subject was that of *Western Union Telegraph Co. vs. Champlain Electric Light Company,* Clark County Common Pleas, November 12, 1885, 1 *Am. Elect. Cas.* 922, in which a temporary injunction was allowed at the suit of the telegraph company against the light company restraining the latter, which held the later franchise, from stringing its wires so as to injure the telegraph company. The court found that placing the electric light wires at the ends of nine foot crossarms on poles at that distance below the telegraph wires would not endanger the plaintiff's linemen if they used proper care in ascending the poles.

In *Western Union Telegraph Co. vs. Guernsey & Scudder Electric Light Co.,* 40 *Mo. Ap.* 120 (1891), 3 *Am. Elect. Cas.* 425, the plaintiff had its telegraph lines in the streets of St. Louis which had been in use four years when the defendant light company constructed a lead of poles higher than plaintiff's poles and placed its wires partly above and partly below plaintiff's telegraph wires, using same to transmit heavy electrical currents. A restraining order was entered enjoining the defendant from transmitting any electric currents through its wires strung below those of plaintiff on account of the danger to plaintiff's employes and prohibiting the defendant from stringing any more wires below the wires of plaintiff; also from placing any electric light wires above those of plaintiff nearer than three feet to plaintiff's wires; also requiring the defendant to place some net work below its wires already strung sufficient to prevent its wires in case of breakage or sagging, from coming into contact with plaintiff's wires. At the final hearing, the restraint as to the lower wires of defendant was removed on the ground that such wires were only there for temporary purpose. The rest of the injunction was modified by enlarging the space which was to intervene between plaintiff's and defendant's wires from three to eight feet, and as thus modified was made perpetual. The court was of

the opinion that the plaintiff's rights and duties as a common carrier under national and state laws had a material bearing in determining the question as to what interference was substantial enough to warrant the interposition of a court of equity, so, at page 439:

> It is in this connection that the plaintiff's rights and duties as fixed by law are material. The plaintiff is a carrier in the service of the public, and its duties as such are regulated by law and enforced by the severest penalties. It is answerable in its penalties for any neglect in the safety and accurate transmission of messages intrusted to its care. . . . The plaintiff, therefore, has a right to insist that a rigid protection of the law should be thrown around the instrumentalities which are essential to the faithful performance of its duties. The defendant is a mere volunteer. It makes whatever contracts it pleases with customers of its own selection and even in cases of breach is answerable for ordinary damages only.

In *Western Union Telegraph Co. vs. Los Angeles Electric Co.*, U. S. Circuit Court, California, August 3, 1896, 5 *Am. Elect. Cas.* 202, the court held that the two uses of the street for telegraph and lighting purposes were of equal necessity and that prior occupancy gave the better right, and granted an injunction against the defendant, the electric light company, from operating its lines of electric wires on a certain street in Los Angeles where plaintiff's wires were located.

(To be concluded.)

American Telephone's Large Shareholdings

Probably no large corporation in the United States occupies such a unique position as regards the distribution of its shares as does the American Telephone & Telegraph Company. On June 30, 1913, it had 53,737 shareholders, being exceeded only by the United States Steel Company and Pennsylvania Railroad as to the number of shareholders, with 124,094 and 84,244 stockholders, respectively. Neither the Pennsylvania Railroad nor the United States Steel, however, can boast of the fact that 60 per cent of their shareholders are residents of a single state or that 53 per cent of their total outstanding share capital is owned in a single state. Such is the case with the American Telephone Company.

On April 1 the American Telephone Company had 223 stockholders owning 1,200 shares each or over—excluding brokerage houses—of whom 129, or 58 per cent, were residents in Massachusetts. There are a surprisingly large number of women stockholders, while a very extensive share interest in the company is held by trustees. This is especially true of trustee holdings in Boston and vicinity.

The Atlantic & Pacific Telephone & Telegraph Company was the largest stockholder of the American Telephone Company on April 1, 1914, with 128,279 shares. The Bankers Trust Company of New York as trustee, with 55,948 shares was second. This trusteeship is under an agreement dated July 30, 1912, for 2,000 shares, and trustee for 53,948 shares under a certain stock trust agreement between the trust company and the telephone company, dated March 23, 1911.

Joseph J. Slocum, of New York, was third on the list, and is the largest individual stockholder in the company, with 20,400 shares. Zenas Crane, of Dalton, was fourth, with 18,323 shares and George F. Baker, of New York fifth, with 16,760 shares. The stockholders' list on April 1, 1913, credited Harvard College with 2,666 shares. On April 1, 1914, it was credited with only 321 shares. J. P. Morgan estate last year was listed with 2,142 shares. This year the estate is listed with no shares, but J. P. Morgan, as trustee, appears as a holder of 1,136 shares. William Skinner and Joseph A. Skinner, of Holyoke, were credited with 2,140 shares and 1,360 shares, respectively, in 1913. This year neither of the two names appears on the stockholders' list. The Adams Express Company does not appear on the list this year, whereas last year it held 2,781 shares.

Former Senator Crane, a director in the company, ranks as the eighth largest individual shareholder, with 13,000 shares. In 1913 he was credited with 16,000 shares. On the other hand, Zenas Crane, of Dalton, increased his holdings from 16,442 shares to 18,323 shares. Zenas Crane and W. M. Crane jointly own 31,323 shares, while including the entire shareholdings of the Cranes of Walton, the ownership of this one family in the American Telephone Company approximates 43,633 shares, with a present market value of rising $5,190,000.

Charles F. Ayer, of Lowell, has 600 shares less this year than last. The Home Insurance Company, of New York, disposed of 2,000 shares during the year, reducing its interest from 3,500 to 1,500 shares. Gordon Bill, of Springfield, increased his interest by 800 shares. William A. Gaston, of Boston, added 200 shares, increasing his interest to 1,335 shares. Robert Saltonstall, of Milton, added 1,000 shares.

President Lowell of Harvard College is on the stockholders' list, with 1,812 shares; U. N. Bethel, a director of the company, with 1,800 shares, and John L. Saltonstall, of Beverly, with 1,525. George R. White, the largest individual taxpayer in Boston, owns 1,500 shares; Alexander Cochrane, of Boston, 1,500 shares, and Morton F. Plant, 1,440 shares. Samuel Carr, of Boston owns 1,246 shares, and A. N. Milliken, of Cohasset, 1,200 shares.

Among the prominent shareholders credited with from 1,000 to 1,200 shares, each, on April 1, last, might be mentioned E. S. Draper estate, with 1,000; Cyrus H. McCormick, Chicago, 1,001; J. P. Morgan, trustee, 1,136; Museum of Fine Arts, Boston, 1,051; Augustus Hemenway, Boston, 1,100; Nelson W. Aldrich, Providence, 1,000; Vincent Astor, 1,000; Old Colony Insurance Company, of Boston, 1,000; Old Colony Trust Company, of Boston, 1,050; Bowdoin College, 1,036; B. B. and R. Knight, Providence, 1,000; Thomas L. Livermore, Boston, 1,000.

Kidder, Peabody & Co. is the largest brokerage house holder, with 19,381 shares, followed by White, Weld & Company, with 15,657 shares. Total shareholdings credited to bankers and brokerage houses on April 1, last, was 188,976 shares.

Oklahoma Telephone Men Convene

The Fourteenth semi-annual meeting of the Telephone Association of Oklahoma was held at the Lee-Huckins hotel, at Oklahoma City, Okla., with a total of forty-five representatives of as many telephone companies of the state present. L. T. Hine of Purcell, presided, in the absence of the president, Horace Trueman, of Geary, Okla.

Addresses were made by Ezra Pennington of Oklahoma City, H. Flickenger of Kingfisher, L. T. Hine of Purcell, and H. E. Musson of Oklahoma City. Arrangements were made for a big annual meeting to be held in February. On display on the parlor floor of the hotel were exhibits by telephone supply houses.

The meeting was closed with a banquet.

Indiana Commission Urges Merger

The Public Service Commission of Indiana recently sent letters to the Central Union Telephone Company and the Indianapolis Telephone Company, ordering them to submit immediately physical valuations of their local exchange properties and pointing out that neither company apparently has made any effort to further the plans of the commission looking toward physical connection or a merger of the two telephone companies in Indianapolis.

The letters mean that the commission immediately will push its plan to compel a merger or at least a physical connection between the two telephone systems. The proposal that the two local telephone companies "get together" and abolish the duplication of service came from Charles J. Murphy, of the commission, in a letter to the companies, warning them against proposed duplication of property.

Many months ago the Central Union Telephone Company petitioned the commission to allow a rate revision in this city and a transition from the present flat rate to the measured service system of rates. This petition was not acted on. Members of the commission expressed the belief that the measured service system or rates for telephones is the most scientific method of handling the telephone rate question.

The letter from the commission to the Central Union Telephone Company follows:

This commission begs to direct attention to its letter of Dec. 12, 1913, bearing on the telephone situation in the city of Indianapolis, especially to that feature of the letter above referred to contained in the last paragraph hereinafter quoted:

Public convenience and necessity demand a single and complete service, which is only possible by a consolidation between the Central Union Telephone Company and the Indianapolis Telephone Company for both local and long distance service. This, then, should be necessarily worked out if there is to be a readjustment in rates of either company.

It is the desire of this commission that you immediately undertake the solution of this problem, and as soon as possible submit to the commission a basis for its consideration on which the proper solution can be brought about, which will be fair to the public and companies as well.

Public sentiment as evidenced through the press and by petition leaves no doubt in the minds of this commission that a large majority of the telephone users in the city of Indianapolis are dissatisfied with the present dual service condition and desire instead a single or unified service, which will bring about a complete service without the necessity of incurring the expense and added nuisance of two telephones.

Your company has as far as this commission knows taken no steps (as suggested in the paragraphs above quoted) in the direction of assisting or lending co-operation toward bringing about the condition which the public demands. The commission therefore in this way begs to again call your attention to the matter in the hope that you will realize that the interest of the public as well as your company can be better conserved by lending your assistance to this commission in its attempt to bring about better telephone conditions in the city of Indianapolis.

You are hereby directed to submit to this commission at the earliest possible date a detailed physical valuation of your Indianapolis local exchange property.

Washington Commission Overruled

The Washington state public service commission has been overruled by the superior court of Thurston county, which is the trial court for all actions against the state, holding that in making an order to compel the Skagit River Telephone & Telegraph Company to make physical connection with the Puget Sound Independent Telephone Company, both doing business in Skagit county, it was going beyond its jurisdiction, since this would merely establish competitive service. The court accordingly denied the commission's motion for peremptory writ and overruled its demurrer to the affirmative defense of the Pacific Telephone & Telegraph Company, the third defendant company, which has a contract with the Skagit Company and physical connection of lines.

The case developed from a complaint of the Commercial Club of Sedro-Wooley, asking the commission to require physical connection between the Skagit and the Independent companies, which would form a continuous line of communication between localities not reached by separate lines of either. Order for connection followed, and the third company, the Pacific, which has a contract with the Skagit Company covering service in that territory, asked for a restraining order against enforcement of the order.

The memorandum decision finds, according to the evidence, there now exists a continuous line of communication between localities served by the Skagit Company and all localities within telephonic distance thereof served by the Pacific system, including all the localities reached by the lines of the Independent system. Citing higher court decisions in which it has been held that "the whole theory of the law is opposed to the idea that the public will be better served with two parallel lines where one will amply suffice" and "that two companies furnishing the same service is, under the law, an imposition on the taxpayer unless warranted and justified," and also referring to the dual system of telephones that have been maintained in some cities of the state, to prove the above premises, Judge Mitchell makes his decision against the commission order, with judgment dismissing the action.

Wisconsin Establishes Service Standards

The Wisconsin Railroad Commission has issued orders establishing standards of service for all telephone companies in the state. Briefly the orders provide as follows:

Telephone lines must be equipped and maintained so as to eliminate cross-talk and noise which unreasonably interferes with the transmission of messages for ordinary distances.

The number of subscribers on any line must not be greater than that consistent with adequate service.

Each company furnishing service alone or jointly with other companies in two or more cities villages or other exchange points, must provide at least one line for through traffic between such points.

Lines, instruments and other equipment must be properly maintained and inspected whenever necessary.

Each exchange must have sufficient switchboard capacity and sufficient operating force.

Reasonable provision must be made against failure of service from storms or other causes.

Exchanges serving 500 or more subscribers must answer 94 per cent of their calls within ten seconds or less and all other exchanges must answer 90 per cent of their calls within that time.

Companies having 1,500 subscribers must issue directories at least semi-annually and all others at least once a year.

The Chinese government has decided to establish telephonic communication between Shanghai and Nanking. A new wireless station, constructed for the Chinese government by Siemens, at Woosung, has just been completed; it forms one of a chain of six Telefunken stations.

Of Interest to the Trade

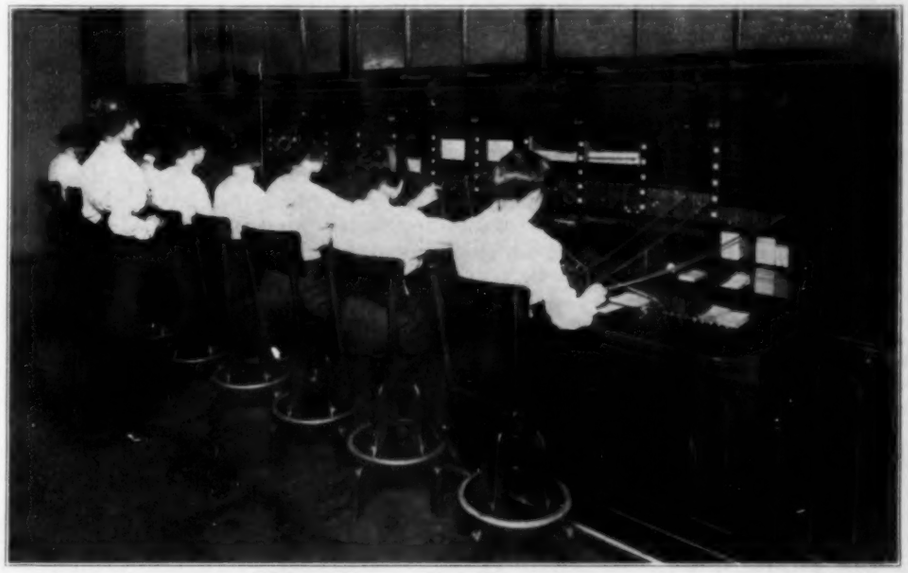
What the Telephone and Accessory Manufacturers Are Doing to Advance the Art

Cape Girardeau, Mo., Has Excellent Service

No higher praise can be given a public utility company, says A. H. Hinchey in the *Cape Girardeau Republican*, of Cape Girardeau, Mo., than to say that it furnishes splendid service. When it is a telephone service that is under consideration, it becomes more vitally necessary that it be good than in the case of any other service agency, because the telephone service is one of the most vitally important conveniences of a large community.

Among the most satisfactory telephone services of the country, that of Cape Girardeau occupies a conspicuous place, it being freely said by those who use it that it is truly excellent, the board being of Kellogg Switchboard & Supply Company's make.

In many cases the public is prone to criticize public service corporations, but owing to the persistent efforts made by the Cape Girardeau Company to please its patrons, it is seldom, indeed, that one hears the telephone service condemned. On the other hand almost every one takes pleasure in saying good things about it.



Kellogg Switchboard and Operators at Cape Girardeau, Mo. Fourteen Hundred Subscribers Are Served by This Exchange, With Free Service to Jackson.

The growth of the telephone system in Cape Girardeau is indicative of the city's growth, as in the past few years the system has grown from a small local line, connecting a few business houses and residences of the town, to a system serving every business house and nearly every residence in the city.

Fourteen hundred subscribers are served by the Cape exchange, 725 by the Jackson exchange, 75 by that of Oak Ridge and an unlimited free service is furnished between Cape Girardeau and Jackson, the county seat, and with nearly every other town in the county. The service to Jackson is especially good.

In conjunction with the daily rural mail delivery and the formation of rural clubs in nearly every community in Cape County, the service given by the Cape Girardeau Telephone Company has greatly bettered living conditions all over the county, offering the farmers of any community in the county an opportunity to keep in touch with all other communities.

Not only has the Cape telephone company kept pace with the growth of the towns, but also with the wonderful expansion that has been going on in the agricultural districts, which is giving to every Cape county farm the silo, a more comfortable house, better implements and a more scientific method of farming.

The number of calls handled daily at the Cape Girardeau exchange varies from 10,000 to 18,000, and the average time required to complete connections is 2.8 seconds, as shown by numerous tests.

The company is now installing additional facilities to care for 540 more local lines, another indication of the growth going on in Cape Girardeau.

The Cape Girardeau Telephone system includes lines to Chaffee, Advance, Festus, and Farmington, Mo., and Chester, Ill., and exchanges are maintained at Ste. Genevieve and St. Marys as well as Cape Girardeau.

The company occupies a fine building in Broadway, in the center of the city, which is fitted up not only for the expeditious handling of its large business, but with the convenience and comfort of its employes in mind. The operating rooms are large and airy, and rest rooms for the girls make it a pleasant place in which to work.

The officers of the company are: H. L. Rozier, president; John Tlapek, general manager; C. W. Boutin, secretary; Jas. F. Brooks, treasurer; and A. W. Berry, superintendent of plant.

Stromberg's Combination Telephone

At last a combination telephone has been designed, by the Stromberg-Carlson Telephone Manufacturing Company, to give maximum efficiency under the most trying conditions. The new telephone embodies several commendable features of the old type, together with several new features, making it a combination telephone without an equal.

The accessible wiring arrangement is a noteworthy feature, as the transmitter does not have to be dismantled to make any changes in repairing the instrument. The transmitter cup is attached to the diaphram with a nut and check nut, thus preventing the transmitter working loose during transmission.

The receiver being of a solid construction, the cords are not very easily broken. The cords are also attached to the instrument by means of a color code; thereby eliminating all mistakes in the connections. Furthermore, an

expert telephone man is not required to assemble the instrument. Cords are made in a rope form, are flexible, fast colored and heavily braided.

The extreme lightness and convenience of this instrument should appeal particularly to the business man. Further information regarding this new type instrument can be obtained by applying to the Stromberg-Carlson Telephone Manufacturing Company, at Rochester, New York.

County Ownership Defeated in Nebraska

York County, Neb., has turned down the proposition to vote nearly a quarter of a million dollars for a county owned telephone system, the vote being 952 for and 1,951 against. The opponents to the proposition carried eighteen out of twenty-one precincts.

The proposition was to establish a county owned telephone system under the Fuller bill, in which $220,000 in bonds was proposed, and the vote also included a maintenance levy authority. A special election was held August 11. Telephone company representatives ascribe the defeat to the unwillingness of the taxpayers to shoulder the burden of managing and maintaining a telephone system.

The Switchboard Installed at Greenville, Pa.

By D. C. Gould.

The Union Telephone Company, of Erie, has completed the installation of a new switchboard equipment in its new exchange building in Greenville, Pa., and all calls are now being handled from the new board. The board is of the common battery, multiple type, manufactured and installed by the Kellogg Switchboard & Supply Company, Chicago.

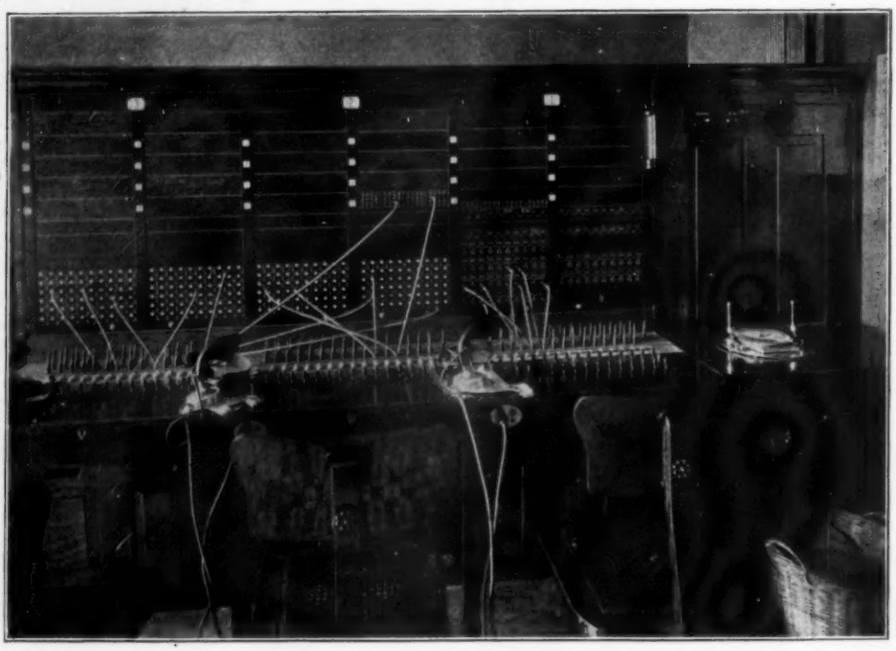
The "common battery" feature provides for a storage battery at the exchange, which furnishes electric current for all subscribser, including current for the transmission of messages, signaling subscribers and calling central. This feature dispenses with two essential parts of the old local battery telephone, namely, the generator for generating current to signal central, and the local battery which provides current for the transmission of messages between the subscribers.

When a subscriber wishes to call a party, he simply lifts the receiver at his telephone off the hook. This instantly lights a small white electric lamp associated with his line at the switchboard which notifies the operator that her attention is required. The operator inserts the answering plug in the line jack corresponding with the lighted lamp which operation extinguishes the lamp. In reply to the operator's familiar "Number, please?" the subscriber gives the number of the party wanted and the operator then inserts the calling plug in the line jack of party called for and signals him.

Each cord circuit is provided with double supervisory lamps. When two parties are talking, these two supervisory lamps are not illuminated, but as soon as either one or both subscribers hang up the receiver, they are lighted. This signal indicates to the operator that the conversation is ended and, therefore, the connection should be taken down. If one of the supervisory lamps remains lighted, it indicates to the operator that one of the parties still further desires her attention.

A special feature of the new board that will be appreciated by the subscribers is that which prevents the operator from accidentally ringing a subscriber in the ear. The signaling system is known as the Kellogg four-party harmonic selective and provides for four parties on the same line, each party answering to one ring. This system is controlled at the central office by a machine known as the harmonic converter which is in reality a ringing machine divided into four units, each unit tuned to a different vibration frequency. No. 4 unit is tuned to 16 vibrations per second, No. 1 unit to 33 vibrations per second, No. 2 unit to 50 vibrations per second, and No. 3 unit to 66 vibrations per second. Telephone instruments are numbered in the same order, one, two, three and four, and the ringers are similarly adjusted so that if the operator rings on No. 3 key only the No. 3 ringer will respond, Nos. 1, 2 and 4 remaining silent. It is impossible for one subscriber to call another subscriber on the same line as heretofore. If he desires a party on the same line, he will call the central office in the usual way, replace his receiver on the switchhook until the operator signals the party asked for.

Another special feature is that which prevents the operator from listening to any local conversation after the connection is established. This is known as "secret service." As the board is not equipped with a listening key the operator answers a call by inserting the switchboard plug in the jack showing the signal light, which automatically cuts in her listening circuit. When she establishes the connection the listening apparatus is automatically cut off from the connecting cords. As there



New Switchboard of the Union Telephone Company, Greenville, Pa.

are no levers to throw, it is impossible for the operator to disturb or interfere with any connection.

In order to change from the old local battery system to the new common system, it was necessary to cut condensers in at each of the old telephones. This, however, is only temporary as the old local battery telephones will all be removed and new common battery instruments installed as soon as the work can be done.

A new wire chiefs desk was furnished with the

Wire Chief's Desk and Terminal Room.

board and also complete terminal equipment, including a No. 10 Cook rack.

Sprayed Metal for Wood Protection

What is claimed to be a new process for the protection or preservation of wood or metal is contained in the Schoop process of the "pulverization and spraying of metals." This is apparently a contradictory statement as we are accustomed to thinking of metal as being firm and hard, while we are quite familiar with the spraying of liquid; however, this process first pulverizes, melts and through means of a high pressure jet of heated gases, sprays the metals upon the surface to be protected or covered.

The extremely compact little apparatus is so designed that jets of oxygen and hydrogen stream out at a high speed and are ignited on emergence, thereby forming an oxy-hydrogen blow pipe which melts a portion of the projecting metal, which is fed into the apparatus in the form of wire, and at the same time pulverizes it and throws the particles forward under pressure. Feeding the wire into the mechanism periodically, a spraying apparatus is obtained by means of which even substances fusible with difficulty can be worked easily and continuously. As the gas enters the mechanism it operates a small air turbine which regulates the feeding of the metal wire.

Microscopical sections of sprayed work have been taken and these show how closely the sprayed metal adheres to the surface on to which it is projected. The micro-photographs of the deposits and adjacent surfaces are interesting. One shows a coat of lead sprayed on wood magnified about 170 times, the pores of the wood being completely filled up and the boundary line between the metal and wood being hardly perceptible. Another shows a rough copper surface sprayed with lead and the penetration into the smallest irregularities of the sprayed surface is still noticeable, the irregularities of the copper surface being entirely filled up, and the assumption of the inventor that in some cases an alloy of the metals is formed at the boundary line seems to be borne out. A coating consisting of imperceptibly fine particles, the thickness of which may be from a few thousandths of an inch to as thick as a third of an inch or more, according to the period of treatment, can be obtained. This coating is always equally dense and homogeneous and can be made adherent or removable according to the preliminary treatment of the surface to be coated. Any metal can be sprayed, such as lead on wood, zinc on iron, copper on iron, gold, silver and even aluminium on any metal or wood, and, in fact any combination desired may be obtained.

In the telephone field it seems there should be quite a demand for a device of this kind. In the telephone transmitter the electrode in the carbon cup can be sprayed with gold instead of plated, effecting a saving both in time and in the amount of metal used and the electrode does not have to be especially treated; in fact, could be made of iron, one side being sprayed with gold and the balance with copper for conducting. The same is true of other parts which must now be made of brass. These can be made of any metal and sprayed with brass. Terminals that are trimmed at present can be sprayed with the trimming material. Uneven or irregular surfaces that are difficult to galvanize can be protected from the weather cheaply and effectively. Pole butts can be coated at the earth line with copper or zinc by this process. Split cross arms can be protected and the cracks sealed; in fact any number of places where this spraying device can be used to advantage will immediately occur to our readers.

The American rights for this process are owned by the Metals Coating Company of America with offices at 122 South Michigan avenue, Chicago, where any additional information regarding the process or samples of the work done can be obtained.

U-S-L Management and Staff Retained

In the United States District Court in Buffalo on July 21, Judge Hazel appointed James O. Moore and James A. Roberts receivers for the U. S. Light and Heating Company following a case in equity. That it was a case in equity and not in bankruptcy was made evident in the hearing.

It was clearly outlined by the court that there should be no interruption in the fulfillment of existing contracts, in the prosecution of pending business or in the company's operations in any department.

A. H. Ackermann, vice-president and general manager prior to the receivership, was immediately appointed general manager to operate the business, because of his familiarity with it, and the entire staff of salesmen, engineers, etc., were retained in their former capacities.

Mr. Ackermann has issued the following statement to the trade and to the public:

The action recently sustained in the appointment of the receivers for the property of the company was a necessary step to conserve the assets for the benefit of all. With assets of three dollars for every dollar of debt, the company is amply stable, and the court's direction to continue the business is the last proof necessary to reassure the buying public. There are already under way plans for broad financing, and with the return of general prosperity in the country, the USL, more aggressive than ever before, intends to secure its own full share of the business and to continue the manufacture and sale of its special electrical products.

An Interesting Trade Letter

Following is a copy of a letter just sent out to the telephone trade by Philip Nungesser, of the Nungesser Carton & Battery Company:

Gentlemen: Your business was one of the main factors in putting my business on the map. When I say your business I mean the telephone industry in general. On September 7, 1889, I made and sold a dozen dry cells for $9.00—75 cents apiece. These were the first commercially successful dry batteries ever sold in the United States—although, of course, I had made innumerable experimental batteries before this first successful dozen arrived.

Philip Nungesser.

Our market was very limited in those days. Consider that was twenty-five years ago—an even quarter of a century—and that about the only possible uses for dry cells in those days were door bells, burglar alarms, fire alarms, etc.

Then your business came along—and I recognized in the telephone industry a great new outlet for dry cells. But I certainly had an uphill problem on my hands. Telephone men told me frankly I was crazy when I first talked dry batteries to them. They said that a little zinc cup without any free liquid could never give the service.

But you know today, in your own experience, how the dry cell has replaced the old wet batteries in the telephone business.

And therefore, I acknowledge the courtesy of *your* industry in helping *me* to put *my* business on the map.

The general feeling throughout the telephone trade—both manufacturers and exchanges—that Nungesser batteries have stood up under the test of time, is a thing that means more to me than anything else in my business experience. Even the men who are not using my product share this belief in it with those who are using it. And I have a feeling—such is my faith in my batteries—that those who are not using my product are using some other because the other fellow's salesmen happen to be on the spot first or oftener than my men.

I have brought up these points simply for the purpose of bringing home to you the fact that my dry cells were the pioneers in the telephone business from the very beginning—and to keep fresh in your mind the fact that my 1900 telephone batteries are, to the best of my belief, the batteries you should be using.

If, for any reason, you are not at present using 1900 batteries, won't you give them your full consideration for next year? Any jobber or telephone manufacturer can supply you or we can ship direct from our factory.

And I want to thank you again, whether you are now a user of my product or not, for the fact that *your* business so materially helped to put *my* business on its present widely known basis.

Indiana Convention

Announcement is made by Walter J. Uhl, secretary-treasurer of the Indiana Independent Telephone Association, that the eighth annual convention of that association will be held Wednesday and Thursday, September 16 and 17, at the Claypool Hotel, Indianapolis. From all indications so far, the convention will be able to show a large and enthusiastic attendance. Mr. Uhl says:

> The friendly interest evidenced by TELEPHONE ENGINEER in the past toward Independent telephone companies is remembered with much appreciation by those identified with Independent companies throughout the State of Indiana.

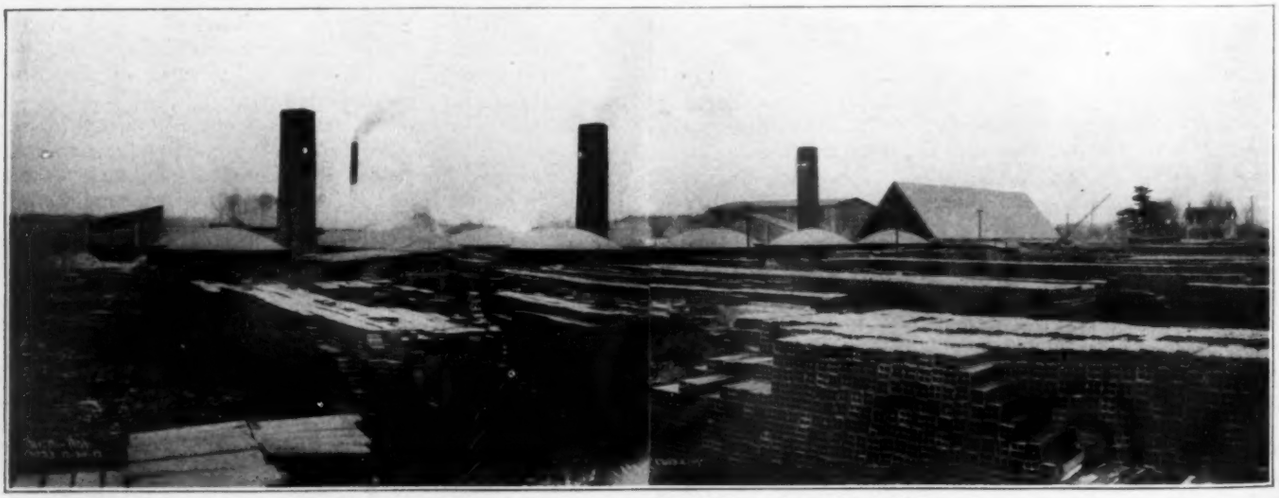
The German army maintains a portable telephone equipment, comprising thirty wagons, drawn by 160 horses, sixty telephones and about seventy-five miles of wire and cable. On October 1 the telephone will entirely displace the telegraph in the army.

Clay Product's New Plant

The illustration below shows the new conduit of the Clay Product Company, at Brazil, Indiana, erected on the site of the old plant which was destroyed by fire some time ago.

This new factory represents an investment of over $375,000, having in operation not only the newest types of clay working machinery, but some specially designed machines that work tremendous economies. One of these machines or systems does work with three or four men that formerly took twenty-two men, so that although the company employs a great many more men than heretofore, because of its increased facilities, the cost per unit of production has been materially decreased, and according to its advertisement in this issue, it is quoting lower prices on clay conduit than ever before.

The high quality of this conduit with the new scale of prices will undoubtedly attract a large amount of new business. An indication of this lies in the fact that the company is now operating three factories; one on conduit and two for turning out the "Dennison" building tile which this company is manufacturing.



Newly Completed Plant of the Clay Products Company, Brazil, Ind.

Brevities of the Business

The Activities of the Whole Telephone Field Told in Short Paragraphs

PERSONAL NOTES.

Ormond F. Cassaday, "Duke" to his many friends in telephony, is a man who would get into the telephone business in spite of even parental objection. At fifteen he was attending the Collegiate Institute of Detroit and became interested in electric lighting. He got a job with the Michigan Electric Company of Detroit. From there he went to London, Canada, and worked on telephone construction for a year. At Sarnia, Canada, he was employed later by the Street Railway and Electric Lighting Company. After this, with the Canadian Bell Telephone Company, he helped in a large common battery cut-over at London—his first serious telephone experience. From here he went to the Central Union at Columbus, Ohio, in installing work. Mr. Cassaday gained a wide experience in switchboard maintenance in 1901, when working for the Akron People's Telephone Company. After this, he was manager at Cuyahoga Falls, where he remained until 1906. An offer to take up work in the engineering department of the Western Electric was accepted, but Mr. Cassaday soon returned to Akron and worked at an automatic cut-over. From here he went to Cleveland, Ohio, on switchboard reconstruction, and as assistant superintendent of equipment in 1907. After this he went to Detroit on equipment inspection and at the close of 1908 to Kansas on engineering propositions and rebuilding telephone plants. A year later found him back in Ohio working for the United States Telephone Company on estimates and appraisals in various parts of the state. In this work, Mr. Cassaday had considerable service experience in the reconstruction of central office equipment. It was in 1910 also, when with the United States Telephone Company, that he did a great deal of estimating and appraisals and special engineering in connection with automatic work and automaic long distance calling. In 1912 Mr. Cassady was promoted to superintendent of equipment with the United States Telephone Company at Columbus. At Columbus "Duke" had charge of the maintenance of the Central office and toll equipments of the United States Telephone Company and subsidiary properties. He also made transmission studies and rebuilt toll and central office equipments throughout the state, increasing the service and transmission efficiency. At this time he was given special consulting engineering work for the Jackson Home Telephone Company and the Hillsboro Home Telephone Company and has gained an enviable reputation in the rebuilding of central office equipments and the appraisal of complete plants. Mr. Cassaday in 1906 married Miss Isabelle Thomas of Cuyahoga Falls. Their home has been in Columbus, but Mr. Cassaday plans to make Chicago his headquarters, as he has cast his lot with the Kellogg Switchboard and Supply Company.

Fred J. Heavens of Pittsburgh has been appointed as service engineer of the Western Pennsylvania Independents. Mr. Heavens will take complete charge, devoting much of his time in investigating exchange equipments of member companies.

A. A. Kronk is announced as the latest addition to the sales force of the Garford Manufacturing Company at Elyria, Ohio. Mr. Kronk has been in the telephone field for some time and will travel out of the company's Kansas City branch covering Oklahoma, northern Texas and adjacent territory.

Miss Kitty Gang, long distance chief of the Bloomington-Kinloch Telephone Company, has been engaged as traveling instructor to visit those exchanges which are members of the Iowa Independent Telephone Association in order to give instructions and suggestions in local and long distance operating. It is expected that Miss Gang will be instrumental in assisting to improve general operating methods.

T. McCullough has been appointed to succeed M. J. Perry as manager of the Martin Telephone Company at Johnston City, Texas.

D. Budge, general station superintendent of the Halifax and Bermuda Cable Company, Halifax, N. S., accompanied by Mrs. Budge, has returned from a visit of several weeks to England.

C. W. Mason, formerly the Western Union Company's manager at Evansville, Ind., has been appointed to the management of the Fort Wayne, Ind., office. He is succeeded at Evansville by Mr. R. E. Eckler, transferred from Muncie, Ind. W. A. Mossman, of New Albany, succeeds to the management of the Muncie office. C. E. Honeter of Brazil has been appointed manager at New Albany. John T. Curtis of North Vernon, Ind., succeeds Mr. Honeter at Brazil, and E. H. Pogue, formerly an operator at Madison, has been appointed manager at North Vernon, vice Mr. Curtis, transferred.

C. G. Foye, Steele, N. D., has taken over the management of the Cleveland Telephone Company at Cleveland, N. D.

W. S. Gifford, statistician, American Telephone and Telegraph Company, New York, has been in Europe for a few weeks on a pleasure trip.

During the past month Mr. Proctor of the Chicago Telephone Company, Mr. Spangler of the Cleveland Telephone Company, Mr. Evans of East Orange, New Jersey, Professor Shepardson, of the University of Minnesota, and Professor Kellogg of Missouri were guests of the educational department of the Western Electric Company at Hawthorne, Ill.

A man can begin as an assistant in the telephone business and at the end of ten years can still be shooting trouble. Also a man, if he has determination and enthusiasm can start in as office boy and, by "getting under the skin" of the game, at the end of ten years can be operating an exchange. And a great many are operating exchanges with that amount of experience. B. A. Parsons left high school ten years ago and today has at his command the practical experience of almost every office in a telephone plant. He has held, successfully, the most important positions, but it is not always the important offices that count for the making of a telephone man's success. The unimportant positions, especially the beginning unimportant places, are the vital factors. It is not easy to get Mr. Parsons to talk about himself, but the simple record of the positions that he has held in this comparatively brief time, shows that he has the determination and enthusiasm of a successful telephone man. Mr. Parsons is a native of Valley City, N. D., and is now state representative in North and South Dakota for the Kellogg Switchboard & Supply Company, the appointment having been made last month. Upon leaving school, Parsons went out with a trouble shooter for the Valley City telephone exchange. He learned all about trouble shooting, not just the superficial things but all the little details that lie behind the practical knowledge which tells a man when a telephone is not working and "the reasons why." Valley City, though not a metropolis, is a leader in the Northwest, and was one of the first to install exclusively Kellogg common battery

equipment. From trouble shooter Mr. Parsons went to line construction work. Subsequently he held several office positions, including that of collector, and after two years he became wire chief. Two years later he resigned to take up the study of telephone engineering, at Des Moines, Iowa. At the completion of his course he went to Cooperstown as general manager for the Griggs County Telephone Company. Leaving Cooperstown, after several years of successful service, Mr. Parsons accepted a position in the telephone department of the Western Utilities Corporation. This position he later resigned to become traveling salesman for the St. Paul Electric Company of St. Paul, Minnesota.

L. G. Richardson, recently general counsel of the central group of Bell Telephone Company, and prior to that president of the Central Union Telephone Company and the Cleveland Telephone Company, has retired from the service of the central group and becomes associated with the legal staff of the American Telephone and Telegraph Company at Chicago. He was presented with a chest of silver by his old associates in the Central Union Company.

The appointment of Charles E. Davies is announced as traffic superintendent of the Great North Western Telegraph Company, with headquarters transferred from Ottawa to Toronto, Ont.

J. B. Sheldon, fifty-four years old, superintendent of telegraph, Union Pacific Railroad, Omaha, Neb., died July 29 as a result of an operation for mastoid. He was at his office up to July 24. Mr. Sheldon was a native of Canada and was appointed superintendent of telegraph of the Union Pacific May 6, 1908. He was a most progressive railroad telegraph superintendent and was president of the Association of Railway Telegraph Superintendents, 1912-13. He was highly esteemed by all who knew him.

B. H. Brooks, formerly chief engineer of the United States Telephone Company, has been appointed as chief engineer of the Ohio State Telephone Company.

Central Union Telephone Company, at Toledo, Ohio, announces the following change in branch managers: A. C. Arend to succeed Major R. B. Hoover, retired, as manager at Springfield, Ohio. Mr. Arend will be succeeded by F. M. Staples, who will take charge of the offices at Findlay and North Baltimore.

Lincoln Telegraph & Telephone Company, Hastings, Nebr., announces the appointment of A. F. Schonloe of Hastings as commercial manager of the Superior office. Mr. Schonloe was formerly office assistant and collector at Hastings.

Chester F. Goolrich, Fredericksburg, Va., will succeed M. T. Goulding as manager of the Chesapeake & Potomac Telephone Company.

The Garford Manufacturing Company at Elyria, Ohio, announces the appointment of Guy A. Joy. Mr. Joy has joined the sales force and will no doubt prove active in strengthening the company's sales force. His many years of experience and host of friends in the field will assist greatly in the sale of independent telephone apparatus.

P. J. Houlton, newly appointed manager of the Portland office of the Pacific Telephone & Telegraph Company, has arrived to take charge of the work. He has been connected with the Pacfiic Telephone Company for some time in the Portland office. D. J. Butcher, who has been in charge of the office for several months, will leave soon to take up his work as special agent.

NEWS FROM THE FIELD.

CALIFORNIA.

The Natomas Consolidated Company has a crew of linemen installing a telephone line from Verona to Sacramento. When this line is completed the Sutter Basin will also connect with Verona.

ILLINOIS.

To make necessary renewals and improvements that will place the service on an equality with that furnished by metropolitan companies the Rockford Home Telephone Company expects to issue $100,000 of preferred stock of the par value of $100 per share. An automatic exchange and a new building are two of the proposed new improvements which will be made if the stock increase is carried through.

Certificate of the dissolution of the Washington City Rural Telephone Company at Pekin has been filed with the recorder. The company has been operating a line in Washington and in the country adjacent, and the action on the dissolution was taken at a meeting at the office of Attorney C. W. Heyl in Peoria July 20. The resolution did not state the reason for dissolving but the stockholders voted unanimously in favor of it.

The People's Home Telephone Company, Vandalia, capital stock $22,700; to operate a telephone system in Fayette and adjoining counties in Illinois. John Z. Metzger, C. F. Easterday and J. H. Boye, Jr.

IOWA.

The Burr Oak Telephone Company of Wilton incorporated with the following officers: President, W. M. Brammeier; vice-president, William Herr; treasurer, J. W. Brammeier; secretary, E. C. Nienabor.

KENTUCKY.

The Duncan Valley Telephone Company, Monticello, capital $750. Incorporators F. F. Cooper, J. H. Edwards, William Lyons, etc.

Hutchinson Telephone Company, Crockett, capital $225. Incorporators J. E. Ferguson, Robert Gilliam, T. P. Conley, etc.

Citizens' Telephone Company, Whitesburg, capital $3,000. Incorporators Stephen Combs, J. T. Smith, John Ison, etc.

Articles of incorporation of the New Washington Telephone Company have been filed by Henry F. Schowe, Albert R. Miles, Thomas R. Stevens, Charles C. Bottorff and E. C. Eberts. The capital stock is fixed at $10,000, all of which is owned by the incorporators.

LOUISIANA.

A crew of workmen for the Cumberland Telephone Company is busy installing about $10,000 worth of improvements and extensions to the Lake Charles system, including a reconstruction of the pole and wire system in the southern part of the city. Three years ago, when the company spent $35,000 on improvements, it figured that the betterments at that time would take care of the service for eight years. The growth of the city, however, upset their calculations.

MONTANA.

The Springfield Telephone Company, Helena, also organized with its principal office at Belgrade, in Gallatin county, to build a telephone exchange in that city and out from there. They have a capital stock of $1,000, of which $650 has been subscribed. The subscribers are : Arthur E. Cramer, Henry Cramer, Mrs. Henry Crouse, J. A. Forswall, Hampton Hecox, S. J. McGuire, J. C. Miller, State Telephone and Telegraph Company, Alex Sandquist, A. T. Street, Charles Cameron, Mrs. Fannie Wright and Mrs. Mabel Craven, all of Belgrade.

The Springhill Telephone Company has filed articles of incorporation for the purpose of extending a telephone line in a northeasterly direction from Belgrade to Springhill. The capital stock is $1,000, of which $600 is subscribed. The directors are Arthur E. Cramer, J. A. Forswall and J. C. Miller, all of Belgrade. The articles of incorporation have been filed with the county clerk and recorder.

OHIO.

Architects Hubbell & Benes have prepared plans for an addition and alterations to the West exchange of the Cleveland Telephone Company.

The stockholders of the United States Telephone Company of Columbus, O., have elected permanent directors as follows: Frank A. Davis, Samuel G. McMeen, F. R. Huntington and E. R. Sharp of Columbus, Charles A. Otis, Harry Coulby and F. F. Prentiss of Cleveland, Clarence Brew and William Harde of Toledo, George D. Eutis of Cincinnati, A. McL. Marshall and H. C. Kiefaber of Dayton, D. J. Cable of Lima, H. B. Peters of Lancaster and Frank L. Beam of Mt. Vernon.

OREGON.

The Pacific Telephone & Telegraph Company is spending approximately $25,000 in and around Albany providing additional facilities and rebuilding some of the old lines. Considerable new aerial and underground cable will be installed, as well as additional equipment for the central office.

PENNSYLVANIA.

The Keystone Telephone Company for July reports gross earnings of $111,468, compared with $105,668 in the same month last year. The surplus was $28,707, an increase of $3,388. For six months the gross was $767,715, as against $731,839 for the corresponding period in 1913, while the surplus was $206,056, an increase of $22,762.

SOUTH DAKOTA.

The Potter County Telephone Company of Forest City has purchased the Dakota Central Company's lines at Gettysburg and Lebanon, and will build a new line across the river from Forest City, and relocate the line extending eastward from Forest City, greatly improving telephone facilities.